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UNDERGROUND FUEL INVESTIGATION COMPREHENSIVE SITE ASSESSMENT TANK
FARM A ADDENDUM REPORT VOLUME 3 WITH TRANSMITTAL MCAS CHERRY POINT NC
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LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.

**VOLUME III ADDENDUM REPORT
UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT**

**TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA**

June 12, 1992

Law Engineering Job No. 475-07174-04

**Law Engineering, Inc.
Raleigh, North Carolina**





LAW ENGINEERING

GEOTECHNICAL, ENVIRONMENTAL
& CONSTRUCTION MATERIALS
CONSULTANTS

June 12, 1992

Commander
Naval Facilities Engineering Command
Atlantic Division
Norfolk, Virginia 23511-6287

Attention: Code 1821, Mr. Trueman Seamans
Engineer-In-Charge

Subject: **VOLUME III ADDENDUM REPORT OF
UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04**

Dear Mr. Seamans:

In accordance with Naval Facilities Engineering Command Order for Supplies and Services Contract No. N62470-90-D-7625/0004 dated September 28, 1991, Law Engineering is pleased to present this addendum report of our environmental services recently performed at Tank Farm A at the Marine Corps Air Station in Cherry Point, North Carolina. The scope of our services, as described in the attached Additional Site Assessment and Corrective Action Workplan, included collecting soil samples for chemical testing, advancing Hydropunches and installing ground-water monitoring wells, and collecting ground-water samples for chemical testing, and investigating the aquifer parameters in the area of Tank Farm A. The objective of our services was to

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1.0 INTRODUCTION

1.1 Purpose of Investigation

On September 29, 1990, the Commander of the Atlantic Division Naval Facilities Engineering Command in Norfolk, Virginia, contracted with Law Companies Group, Inc. to perform a Comprehensive Site Assessment (CSA) at the Tank Farm A facility at Cherry Point Marine Corps Air Station (MCAS), Cherry Point, North Carolina (Drawing 1.1). The purpose of the investigation was to identify the presence, magnitude and extent of possible free product accumulation and ground-water contamination and to assess potential exposure to subsurface contaminants resulting from the release of petroleum fuels. As stated in Law Engineering's October 11, 1990 CSA Workplan, the objective of the investigation was to provide sufficient data to meet the requirements of Sections 280.63 and 280.65 of 40 CFR Part 280, Federal Technical Standards for Underground Storage Tanks and Sections .0704 and .0706 of Title 15A, Chapter 2, Subchapter 2N, of the North Carolina Criteria and Standards Applicable to Underground Storage Tanks.

The assessment activities presented in the CSA Workplan were completed and a report, entitled Final Report, Underground Fuel Investigation, Comprehensive Site Assessment, was issued to the Commander of the Atlantic Division, Naval Facilities



Engineering Command on April 12, 1991. Based upon the results of the initial assessment, it was determined that additional assessment was necessary to fully characterize the extent and degree of petroleum contamination resulting from the underground fuel release in order to prepare a Corrective Action Plan (CAP). A workplan, entitled Additional Site Assessment and Corrective Action Workplan, presented in Appendix A, was prepared and issued on November 4, 1991.

1.2 Scope of Work

Authorization to proceed with the investigation was granted by the Commander of the Atlantic Division Naval Facilities Engineering Command, Norfolk, Virginia, via Contract/Purchase Order No. N62470-90-D-7625/0004 dated September 28, 1991. As outlined in the contract and the November 4, 1991 Workplan, the Scope of Work included preparation of a health and safety plan, collection of ground water samples via Hydropunch, installation of observation and monitoring wells, collection and analysis of soil and ground water samples, performance of an 8-hour aquifer pumping test, preparation of an addendum assessment report and a CAP. Specific methods employed during performance of the project activities are described within the appropriate sections of this report. This document presents a summary of the additional site assessment activities performed during November and December 1991. The CAP will be presented in a separate document.



1.3 Previous Investigation

An initial investigation, which began in 1984, was conducted at Tank Farm A by NUS Corporation. According to the NUS report (NUS, 1988), fifteen soil test borings were advanced and eight ground-water monitoring wells were installed at Tank Farm A to determine the extent of petroleum fuel contamination at the site. Local ground water flow direction was determined from water levels in the eight wells and estimated to be towards the northeast. Tanks 1106, 1107, 1109 and 1248 passed an Acutest tank tightness test in 1990 and a Tracer test in 1991. Results of laboratory tests performed by NUS revealed that ground water in the vicinity of Tank Farm A is contaminated with petroleum fuel related hydrocarbons. At the time of ground-water sampling, 3 to 6 feet of free phase petroleum hydrocarbons (free product) were present in five of the eight monitoring wells. JP-4 and JP-5 type fuel was verified by gas chromatography to be present in the ground water.

In addition to the NUS assessment, several hydrogeologic investigations have been performed at Cherry Point MCAS. These investigations are summarized in U.S. Geological Survey (USGS) Water-Resources Investigations Reports 88-4034 (Lloyd, 1988), and 89-4200 (Murray, 1990b) and USGS Open-File Report 89-615 (Murray, 1990a). These studies are referenced fully in Section 5.0 of this report. USGS reports include discussions of hydrogeology and quality of ground water from existing



drinking water wells and ground-water monitoring wells located at Cherry Point MCAS.

2.0 SUBSURFACE CONTAMINATION ASSESSMENT

2.1 Hydropunch Investigation

Fourteen Hydropunch samples, located as shown in Drawing 2.1, were collected in the vicinity of Tank Farm A. Collection of these ground water samples was accomplished by driving the Hydropunch sampling system through the unsaturated zone into the water bearing zone. The Hydropunch was then opened to allow ground water to enter into the sample chamber. "Shallow" or water table samples were collected by lowering a small-diameter, decontaminated Teflon bailer into the sample chamber. "Deep" samples, collected below the water table and above the upper confining layer, were obtained directly from the sampling tool in the following manner. When the desired depth for collection of the sample was reached, the Hydropunch screen was opened by pulling back on the body of the tool, allowing ground water to enter into the sample chamber. Subsequently, the sample was transported to the surface with the body of the Hydropunch tool, with lower and upper check valves closed to retain the sample. At the surface, the Hydropunch was inverted and the



ground water sample decanted through a top discharge valve and tubing into laboratory provided sample containers.

The samples were placed into a cooler, packed on ice and shipped to the laboratory for chemical analysis. Custody of the samples was maintained by Law Engineering field staff until shipment at the end of each day. The Hydropunch samples were analyzed for purgeable aromatics according to EPA Method 602 and total lead. In addition, samples from Hydropunches HP-6D, HP-8D, and HP-11S were analyzed for purgeable halocarbons according to EPA Method 601. The laboratory analytical results are summarized in Table 2.1 and documented in Appendix B. These results are discussed in conjunction with the monitoring well sampling results in Section 2.5.

2.2 Monitoring Well Installation

2.2.1 Free Product Monitoring Wells

As specified in the November 1991 Workplan, two Type II monitoring wells were installed in the vicinity of Tank Farm A in an attempt to complete the delineation of the free product plume extent. The locations of the free product monitoring wells, 13GW26 and 13GW27, are shown on Drawing 2.1. As shown, well 13GW26 is



located in the apron area and north of Tank Farm A and 13GW27 is located adjacent to Building 1016 and northwest of Tank Farm A. Soil test boring records, well construction records, and installation details are summarized in Appendix C.

During the installation of the monitoring well borehole for 13GW26, the borehole soils were monitored for emissions of volatile organics with an HNu Systems Model PI 101 Photoionization Detector (PID) in accordance with the sampling procedures specified below:

- o The decontaminated split-spoon sampler was driven to the desired depth interval.
- o The split-spoon sampler was retrieved and immediately opened. Portions of sample aliquots were quickly removed from the split-spoon sampler and placed into two prelabeled airtight plastic bags. Sample handling was executed carefully to minimize the loss of volatile organics. The bags were sealed and placed in a warm location.
- o After approximately 20 minutes, the headspace gas in one of the two bags was tested with the Hnu PID and the peak value recorded. This



procedure was conducted for soil samples collected at each sample depth interval.

- o From the soil samples collected from each boring, the two samples that exhibited the highest soil headspace PID reading were selected for chemical analysis. For those samples, the paired sample was transferred to a laboratory-supplied glass container, placed into a cooler, packed on ice and shipped to the laboratory for chemical analysis. Custody of the samples was maintained by Law Engineering field staff until shipment at the end of each day.

Headspace sampling results from 13GW26 are presented in Table 2.2 and documented in the soil test boring records in Appendix C. Results show that emissions of volatile organics were detected in samples collected from the borehole. Concentrations of contamination were typically greatest approximately 10 to 15 feet below the ground surface, which is in the vicinity of the capillary fringe.

The soil samples were analyzed for total petroleum hydrocarbons (TPH) according to EPA Methods 3550 and 5030, and TCLP lead. In addition, selected samples were analyzed for pH according to EPA Method 9040 and ignitability according to EPA



Method 1010. Chemical testing results for the soils samples are summarized in Table 2.3 and documented in Appendix D. The laboratory testing indicated the presence of low boiling point hydrocarbons (total petroleum hydrocarbons) identified as gasoline in two of the four samples collected for chemical testing. Neither low boiling TPH concentration exceeded 10 mg/Kg, the North Carolina Department of Environmental Management recommended action level for petroleum contaminated soils. No high boiling TPHs were detected in excess of the laboratory detection limit.

2.2.2 Type III Monitoring Wells

As specified in the November 1991 Workplan, two Type III monitoring wells were installed in the vicinity of Tank Farm A in an attempt to complete the vertical delineation of the dissolved contaminant plume. The locations of the Type III monitoring wells, 13GW28 and 13GW29, are shown on Drawing 2.1. As shown, well 13GW28 is located adjacent to the existing well 13GW24 and 13GW29 is located adjacent to existing well 13GW1. Soil test boring records, well construction records, and installation details are presented in Appendix C.

During the installation of the monitoring well boreholes, the borehole soils were monitored for emissions of total volatile organics with an HNu PID in accordance with



the sampling procedures specified in Section 2.2.1. Headspace sampling results are presented in Table 2.2. Results show that emissions of volatile organics were detected in samples collected from both of the boreholes. Concentrations of contamination were typically greatest approximately 13 to 15 feet below the ground surface, which is in the vicinity of the capillary fringe.

The soil samples were analyzed for total petroleum hydrocarbons (TPH) according to EPA Methods 3550 and 5030, and TCLP lead. In addition, selected samples were analyzed for pH according to EPA Method 9040 and ignitability according to EPA Method 1010. Chemical testing results for the soils samples are summarized in Table 2.3 and documented in Appendix D. The laboratory testing did not indicate the presence of either low or high boiling TPH concentrations in excess of the laboratory detection limits in the samples collected from boring 13GW28. The analysis did indicate the presence of high boiling point hydrocarbons identified as diesel in both of the samples collected from 13GW29, which is located in the area of a free product plume. Gas chromatography reveals that the hydrocarbon makeup and elution range of diesel is very similar to that of jet fuels (Friedman, 1991). Therefore, it is possible that due to "weathering" processes, the jet fuel present in the subsurface has developed chemical characteristics similar to that of diesel and kerosene.



Low boiling and high boiling petroleum hydrocarbon isopleth maps are presented in Drawings 2.2 and 2.3, respectively. As shown, the new soil data has not appreciably changed the previously extrapolated extent of soils contaminated by petroleum. It should be noted that soil contamination depicted in the drawings is typically present in the vicinity of the capillary fringe. This indicates that the samples may have been collected from soils contaminated with free product floating on the shallow ground water table and moving through the capillary fringe area. Based upon this, the soil contaminant plumes depicted in the drawings do not indicate the source areas of the contamination but the resultant deep soil contamination due to free product migration.

2.2.3 Type II Observation Wells

Two Type II observation wells, 13GW30 and 13GW31, were installed in the vicinity of existing well 13GW13, which was designed to be used as a pumping well during an aquifer test. The locations of the two observation wells are shown in Drawing 2.1. The soils from the boreholes were not monitored with a PID and no soil samples were collected for laboratory analysis. No petroleum odors were noted by the field personnel. Soil test boring records, well construction records and installation details are summarized in Appendix C.



2.3 Extent of Free Product

All of the Type II monitoring wells at Tank Farm A were constructed to allow for the detection of free product in the capillary fringe area. As indicated on the Monitoring Well Casing and Water Elevation Worksheets presented in Appendix E, measurable free product was detected on December 19, 1991 in monitoring wells 13GW1, 13GW2, 13GW3, 13GW4, 13GW6, 13GW10, and 13GW14. Measured product thicknesses ranged from 1.92 feet in 13GW3 to 3.75 feet in 13GW2. No other monitoring wells, including the newly installed 13GW26 and 13GW27, indicated the presence of free product when measured via probe on December 19, 1991.

Because of differences in the density and capillary pressures of water, oil and air, the measured thickness of free liquid hydrocarbons present in a well is usually greater than the actual thickness outside the well in the adjoining formation. Calculations performed in order to account for these differences reveal that actual product thicknesses in the formation may range from 0.77 feet surrounding 13GW3 to 1.5 feet surrounding 13GW2. Results are based on a 2.5:1 ratio of measured product thickness to true product thickness, which has been shown to be representative of fine sands (Lyman, 1990). These estimated product thicknesses and the estimated spatial extent of free product are shown graphically in Drawing 2.4.



As represented in the drawing, there appear to be four separate free product plumes in the vicinity of Tank Farm A. The largest, which encompasses approximately 450,000 square feet, is beneath and around the tank farm. This plume appears to be directly related to releases from within the tank farm. A second plume is present in the immediate vicinity of monitoring well 13GW10 and appears to be related to a release from the adjacent aviation fuel line present below the apron area, which delivers fuel from Tank Farm B. Based upon the lack of free product in newly installed monitoring well 13GW26, this plume appears to be separate from the free product plume located below Tank Farm A. A third plume, which was identified during the previous subsurface investigation and appears to be related to a release from the adjacent aviation fuel line, is present in the immediate vicinity of monitoring well 13GW14. Based upon the lack of free product in newly installed upgradient monitoring well 13GW27, the free product plume appears to be fairly limited in size. A fourth free product plume was identified in the vicinity of Building 4076 during the Hydropunch phase of the ground water assessment. As indicated on Drawing 2.4, unknown thicknesses of free product were detected in Hydropunches HP-1s, HP-12s, and HP-13s. This plume appears to be related to a release from the adjacent aviation fuel line present below the apron area, which delivers fuel from Tank Farm B.



2.4 Shallow Ground Water Flow Determination

Prior to well sampling, the depths to ground water and free product (if present) were determined at all 31 monitoring wells using an electronic water level probe. The distance from the measuring point to each respective depth was measured and recorded. The data collected and observations made were recorded on the Monitoring Well and Sampling Field Data Worksheets (Appendix F). Based on the ground water elevations measured in the monitoring wells on December 19, 1991, a water table contour map was prepared and ground water flow direction determined, as shown in Drawing 2.5. Calculated ground water elevations from monitoring wells which contained free product were corrected due to the differences in densities between water and fuel. The corrected elevation was derived by multiplying the measured free product thickness by 0.70, the approximate density of the fuel, adding the result to the measured depth to ground water, and then subtracting that depth from the surveyed elevation of the top of casing measuring point. Ground water in the surficial aquifer generally flows across the project site in a northerly and northwesterly direction. There also appears to be a slight depression of the water table in the vicinity of the northeastern corner of the tank farm which may be caused by the product removal efforts underway there in the vicinity of 13GW2.



2.5 Dissolved Ground Water Contamination

2.5.1 Shallow Ground Water Results

Ground water samples were collected from the newly installed monitoring wells (13GW26, 13GW27, 13GW28, and 13GW29). Prior to sampling, personnel donned laboratory grade gloves. These gloves were replaced after sampling each well to prevent cross-contamination. The four monitoring wells were evacuated prior to sample collection to remove the water from the well casing and sand pack in an effort to collect samples representative of the water quality in the surrounding formation. The wells were evacuated using decontaminated, Teflon bailers attached to new nylon cord. Specific conductance, pH and water temperature were measured and recorded throughout the evacuation process. Well evacuation continued until three standing well volumes were evacuated and indicator parameters had stabilized (or until well exhibited dryness). Water samples were then collected and immediately decanted gently from the bailer into pre-labeled sample containers. These containers were sealed, and stored in chilled coolers. Custody of the samples was maintained by Law Engineering field staff until shipment at the end of each day.



The four wells were sampled and analyzed for purgeable aromatics according to EPA Method 602 and total lead. A summary of the ground water analytical results is presented in Table 2.4 and documented in Appendix G. The tabulated results have been combined with the analytical results from the 1990 ground water sampling activities. In addition, the Hydropunch sample results have also been used in interpreting the extent of the ground water contamination. Results show that ground water in the vicinity of Tank Farm A and the aviation fuel lines has been contaminated with typical petroleum fuel related hydrocarbons. In addition, lead was detected in three of the four new wells in excess of the method detection limit. Based upon the ground water contour map of the site, the hydrocarbon contamination appears to be originating within the tank farm and at three additional locations outside of the tank farm compound. Due to the predominant ground-water flow direction, contaminants appear to be migrating in a northerly and northwesterly direction.

Contaminant isopleth maps showing concentrations of benzene, toluene, ethylbenzene, and total xylenes in the shallow ground water are presented in Drawings 2.6, 2.7, 2.8, and 2.9, respectively. An isopleth map for the total concentrations of these four hydrocarbons (BTEX) in the shallow ground water is presented in Drawing 2.10. With respect to the dissolved hydrocarbon contaminants, the primary sources of contamination appear to be located within the Tank Farm A



compound with a high probability of additional sources in the vicinities of 13GW10 and 13GW14 and east of Building 4076. As indicated previously, underground fuel transmission lines are located in the immediate vicinities of these other locations and are suspect as likely sources of releases or as preferential pathways for subsurface fuel movement.

Horizontally, the extent of the dissolved hydrocarbon plumes appears to have been defined with several exceptions. The benzene concentration exceeds the North Carolina ground water quality standard of 1 ug/l in 13GW25 (4 ug/l). In addition, the downgradient extent of dissolved contamination has not been assessed in the vicinity of Building 4076, where free product was identified in three Hydropunches. It is our understanding that additional ground water assessment activities have been conducted by another consultant to the north and northeast of Building 4076 which may aid in the horizontal assessment of the dissolved plume.

Although lead concentrations are typically highest in wells containing free product, a consistent pattern of elevated lead concentrations does not exist at Tank Farm A, as indicated in Drawing 2.11. Lead concentrations in the majority of wells which do not exhibit marked hydrocarbon contamination are generally less than 100 ug/l. However, 13GW5 and 13GW18 (no apparent hydrocarbon contamination) exhibit lead



concentrations of 244 ug/l and 168 ug/l, respectively. Alternatively, several wells (13GW1, 13GW4, 13GW10) which do exhibit significant hydrocarbon contamination show relatively low concentrations of lead. In summary, we are not able to draw any conclusions regarding the probable relationship between lead concentrations detected at Tank Farm A and migration patterns of water-borne lead resulting from petroleum fuel releases.

2.5.2 Deep Ground Water Results

In order to monitor ground water at multiple depths and delineate the vertical extent of ground-water contamination at Tank Farm A, six deep Hydropunches and two deep monitoring wells were installed and sampled. The two newly installed deep wells were paired with existing shallow monitoring wells. The well pairs consist of 13GW1/13GW29 and 13GW24/13GW28, in addition to the previously installed well pair, 13GW10 and 13GW11. Monitoring well 13GW1 is an EPA Type II monitoring well, installed by NUS, which is screened across the shallow ground water table. Newly installed monitoring well 13GW29 is an EPA Type III well consisting of a five foot screen located at a depth interval of 37 to 42 feet below the land surface. The well pair is located at the northeastern corner of Tank Farm A, where free product has been identified. Monitoring well 13GW24 is an EPA Type II ground-water well



screened from 5 to 20 feet below land surface. Monitoring well 13GW28 is an EPA Type III ground water well consisting of a five foot screen located at a depth interval of 37 to 42 feet below the land surface. The well pair is located at the northwest corner of Building 1010.

The six deep Hydropunches were sampled in accordance with the protocols specified in Section 2.1 of this report. The Hydropunch samples were analyzed for purgeable aromatics according to EPA Method 602 and total lead. In addition, samples HP-6D and HP-8D were also analyzed for purgeable halocarbons according to EPA Method 601. The laboratory sample results are summarized in Table 2.1 and documented in Appendix B. The deep Hydropunch sampling results are consistent with monitoring well sampling results from similar locations within the contamination plumes, as shown in the contaminant isopleths shown in Drawings 2.6, 2.7, 2.8, 2.9, and 2.10. The only exception is Hydropunch HP-10D, where an elevated benzene concentration of 820 ug/L was detected. The adjacent shallow monitoring well, 13GW23, indicated only 0.6 ug/L of benzene when it was sampled in 1990. Currently, we have no explanation for the elevated results at such a depth.

The deep monitoring wells were sampled in accordance with the protocols specified in the Workplan. The samples were analyzed for purgeable aromatics according to



EPA Method 602 and total lead. Sampling results associated with 13GW29, the Type III well screened below the free product plume, suggest that ground water present in the lower saturated zone but above the confining layer is contaminated with benzene (560 ug/l) and ethylbenzene (140 ug/l). Sampling results associated with 13GW28, the Type III well paired with 13GW24, suggest that ground water present in the lower saturated zone but above the confining layer is slightly contaminated with benzene (7 ug/l) and ethylbenzene (0.6 ug/l). At this point in the investigation, no ground water monitoring wells have been installed into the upper confining layer at the site.

3.0 SITE HYDROGEOLOGY

3.1 8-Hour Pumping Test

An 8-hour pumping test was conducted on monitoring well 13GW13 to determine the performance characteristics of the well and the hydraulic parameters of the aquifer. Yield and drawdown were recorded so that the specific capacity of the well could be calculated. These data provide a measure of the productive capacity of the well and thus aid in the selection of appropriately sized pumping equipment which will be necessary during the corrective action phase of the project.



The pumping test also provided data from which to determine the transmissivity and storage coefficient of the surrounding aquifer in order to predict:

- o the effect of new withdrawals on existing wells;
- o the drawdowns in a well at future times and different discharges;
- o The radius of the cone of influence for individual or multiple extraction wells. This information will be used in conjunction with the RESSQC and MWCAP modules of the Wellhead Protection Area (WHPA) ground water flow model to delineate time-related capture zones around pumping wells. Capture zone configurations will be presented in the CAP.

3.1.1 Pumping Test Procedures

Several days before the actual pumping test, well 13GW13 was pumped for approximately one hour to determine the approximate well yield. This "pre-test" data was necessary to select the proper size pump and establish the pumping rate to be used during the constant rate pumping test. During the pre-test, a sample, PT-A,B,



was collected from the discharge water, which was temporarily containerized at the site. The sample, which was composited with a sample collected during the pre-test activities at Tank Farm B, was analyzed for purgeable aromatics according to EPA Method 602, total lead, purgeable halocarbons according to EPA Method 601, and semi-volatile organic compounds according to EPA Method 625. As documented in Appendix G, only three constituents (xylenes at 1 ug\L, acenaphthene at 0.5 ug\L, and phenanthrene at 0.5 ug\L) were detected in sample PT-A,B in excess of the laboratory detection limits. Based upon this analytical data, the discharge water was transported to and disposed of at the Cherry Point MCAS wastewater treatment facility.

The 8-hour pumping test was conducted on well 13GW13 on December 17, 1991. During the test, a constant pumping rate of approximately 15 gallons per minute was maintained and the drawdown in the surrounding observation wells, 13GW30 and 13GW31, was measured and recorded at appropriate time intervals. These data are summarized in Appendix H. As summarized, after 8 hours of pumping the extraction well, approximately 6,210 gallons of ground water were extracted and 1.90 feet of drawdown was measured in observation well 13GW30, located approximately 40 feet away, and 0.86 feet of drawdown was measured in observation well 13GW31, located approximately 84 feet away.



3.1.2 Aquifer Parameter Determinations

The data collected during the pumping test were used to calculate the storativity and transmissivity of the surrounding aquifer. These determinations were made by using the modified nonequilibrium equations modified by Cooper and Jacob after Theis where:

$$S = \frac{0.3 T t_0}{r^2}$$

where:

- S = Storativity**
- T = Transmissivity, in gpd/ft**
- t_0 = intercept of the straight line at zero drawdown, in days**
- r = distance, in ft, from the pumped well to the observation well**

and: $T = \frac{2640}{AS}$

where: **T = Transmissivity in gpd/ft**
 Q = pumping rate, in gpm
 Δs = slope of time-drawdown graph

In addition, the data were also analyzed according to the type curve matching method and the time versus drawdown method to determine storativity and transmissivity. These data are summarized in Table 3.1 and the field data and calculations are



presented in Appendix H. As summarized, the calculated storativity ranged from 0.00057 to 0.009 and the calculated transmissivity ranged from 2,500 to 8,400 gpd/ft.

3.2 Hydraulic Conductivity Determinations

Rising head permeability tests were to be performed on five shallow ground water monitoring wells, as presented in the November 1991 Workplan. Initial attempts to conduct the rising head tests were unsuccessful due to the highly permeable soils at the site. Measuring recovery at the wells was not deemed feasible due to the practically instantaneous recovery of the depressed ground water table. Based upon this, a determination was made to collect saturated soil samples from several locations around the site and to analyze the grain size gradation of the saturated soils. Hydraulic conductivity of the surficial aquifer was then calculated based on the results of previous studies performed on unconsolidated sands by F.D. Masch and K.J. Denny (Freeze and Cherry, 1979).

Calculations for Tank Farm A included saturated soil samples collected from boreholes 13GW28 at sample intervals of 13.5 to 15.0 feet and 18.5 and 20.0 feet and 13GW29 at sample intervals of 8.5 to 10.0 feet and 13.5 and 15.0 feet. From these



four grain size samples, 13GW29 at a sample interval of 8.5 to 10.0 feet, was not used due to the higher percentage of silts and clay, which approximated 25 percent. The Masch and Denny formula is applicable to larger grain material. The calculations, as summarized in Table 3.1 and documented in Appendix H, indicate that the surficial aquifer hydraulic conductivity, based upon the grain size analyses, approximates 15 to 33 feet/day at the site. The pumping test data was also used to determine the hydraulic conductivity at the site. Based upon the data, as summarized in Table 3.1 and documented in Appendix H, the hydraulic conductivity ranges from 9.5 to 32 feet/day. Considering the variations in calculation methods, these values are highly consistent.

3.3 Vertical Gradient Determinations

Ground water exhibits both horizontal and vertical components of flow through an aquifer. The hydraulic gradient is, by definition, the difference in hydraulic head divided by the distance along the flow path. The vertical gradient may be either up (toward the land surface) or down (away from land surface) within the aquifer. At Tank Farm A, there are three nested wells which pair a shallow or water table, monitoring well with a deeper Type III monitoring well.



These well nests are:

<u>Shallow Well</u>	<u>Deep Well</u>
13GW24	13GW28
13GW10	13GW11
13GW1	13GW29

The vertical gradient is calculated by first determining the difference in the static water level elevations at each well. Second, the relative elevation of the middle of the screened interval is determined for each well. Finally, the difference in the static water level elevations is divided by the difference in the midscreen elevations. This value is arbitrarily assigned a positive value if the ground water is moving vertically downward and a negative value if the ground water is moving vertically upward. The vertical gradients determined for Tank Farm A are summarized in Table 3.2. As summarized, a very slight upward gradient appears to exist at the 13GW24/13GW28 cluster, and a slight downward gradient appears to exist at the 13GW10/13GW11 cluster. Since the calculated values are so small, and considering the assumptions that must be made in determining the gradients, it appears for all practical purposes that ground water flow is essentially horizontal, with little or no vertical gradient. A



gradient has not been determined for the 13GW1/13GW29 cluster because construction details are not available for 13GW1, which was installed by NUS in 1984.

4.0 QUALITY CONTROL PROCEDURES

4.1 Equipment Decontamination

Quality control procedures for equipment handling and decontamination are detailed in the October 1990 CSA Workplan. Decontamination of drilling equipment was performed at the plane washing rack oil/water separator in the vicinity of Building 130. A sample of the base potable water was collected from the spigot located at the rack and tested for purgeable aromatic hydrocarbons according to EPA Method 602. Laboratory results (identified as "Potable Water" in Appendix G) exhibited no detectable concentrations of benzene, toluene, ethylbenzene or xylenes in excess of the laboratory quantitation limits.



4.2 Sample Collection and Shipment

Details of quality control procedures for sample collection, handling and shipment are included in the October 1990 CSA Workplan. To provide checks on the integrity and quality of the field sampling program performed at Tank Farm A, two quality control measures were employed. First, one equipment rinse blank (laboratory sample number AA15720) was submitted to the laboratory for evaluation of field procedures used to decontaminate the Teflon bailer used during the Hydropunch sampling. Second, three trip blanks (laboratory sample numbers AA15573, AA15721, and AA16381) were submitted to the laboratory to perform checks on the integrity of the sample containers and ascertain whether contaminants may have entered the sample containers during shipment to and from the job site. Laboratory quality controls included the use of lab blanks throughout the analytical procedures to check for laboratory induced contamination.

Based on the relatively low concentrations of xylenes (1.1 ug/l) detected in only one trip blank (laboratory sample number AA15721), we believe that no significant petroleum hydrocarbon contamination of ground-water samples occurred as a result contaminated sampling equipment. Based on an opinion by laboratory personnel that low concentrations of xylenes oftentimes occur due to laboratory-induced



contaminants, we believe that the trip blank was relatively free of petroleum hydrocarbon contamination upon receipt by the laboratory. A low concentration of chloroform (2.1 ug/L) was detected in the rinse blank, possibly due to the use of chlorinated water during field decontamination procedures used to clean the Hydropunch bailer.

4.3 Chemical Data Evaluation

In order to assess the quality of laboratory produced data, a chemical data evaluation or analytical data review was performed. The evaluation included a review of surrogate failures, calibration verification, holding times, organic blank contamination, documentation and sample condition. In summary, the evaluation results indicate that reported discrepancies between actual results/procedures and standard results/procedures are not considered to have major impact on the data reported. A copy of the analytical data review report is included in Appendix I.



5.0 REFERENCES

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TABLE 2.1 (Page 1 of 2)
SUMMARY OF HYDROPUNCH ANALYTICAL RESULTS*
VOLUME III ADDENDUM REPORT OF UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

PARAMETER	HYDROPUNCH #	1B	2B	3B	4B	5D	6D	7D
	SAMPLE DEPTH (ft.)							
PURGEABLE AROMATICS (METHOD 602)		11 TO 14	11 TO 15	11.5 TO 15.5	11.5 TO 15.5	34 TO 35	34 TO 35	34 TO 35
Benzene	Free Product	0.9	2.0	ND	ND	ND	2.0	
Ethylbenzene	Free Product	ND	4.0	ND	ND	ND	1.0	
Xylenes	Free Product	ND	9.0	ND	ND	ND	3.0	
PURGEABLE HALOCARBONS (METHOD 601)	Free Product	--	--	--	--	ND	--	
TOTAL LEAD	Free Product	140	180	120	58	22	5	

NOTES:

ND Not Detected
-- Not Performed
* All results reported in ug/l

TABLE 2.1 (Page 2 of 2)
SUMMARY OF HYDROPUNCH ANALYTICAL RESULTS*
VOLUME III ADDENDUM REPORT OF UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
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LAW ENGINEERING JOB NO. 475-07174-04

PARAMETER	HYDROPUNCH #	8D	9D	10D	11S	12S	13S	14S
	SAMPLE DEPTH (ft.)							
PURGEABLE AROMATICS (METHOD 602)		34 TO 35	38.5 TO 40	34 TO 35	11 TO 14	11 TO 14	12 TO 15	12 TO 15
Benzene		24	10	820	ND	Free Product	Free Product	1
Ethylbenzene		ND	ND	6.0	0.8	Free Product	Free Product	0.6
Xylenes		1.0	ND	1.0	ND	Free Product	Free Product	2
PURGEABLE HALOCARBONS (METHOD 601)		ND	--	--	ND	Free Product	Free Product	--
TOTAL LEAD		250	180	20	22	Free Product	Free Product	32

NOTES:

ND Not Detected
-- Not Performed
* All results reported in ug/l

TABLE 2.2 (Page 1 of 6)
SUMMARY OF HEADSPACE PID ANALYSIS
VOLUME III ADDENDUM REPORT OF
UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

SAMPLE LOCATION I.D. #	SAMPLE DEPTH (ft.)	PID READING (ppm)	SAMPLE SELECTED FOR LABORATORY ANALYSIS
13B1	0 - 1.5 1.5 - 3.0 3.0 - 4.5 8.5 - 10.0 13.5 - 15.0	Asphalt 4 8 52 7	.
13B2	0 - 1.5 1.5 - 3.0 3.0 - 4.5 8.5 - 10.0 13.5 - 15.0	Asphalt BDL BDL 70 8	.
13B3	0 - 1.5 1.5 - 3.0 3.0 - 4.5 8.5 - 10.0 13.5 - 15.0	Concrete BDL BDL 100 80	.
13B4	0 - 1.5 1.5 - 3.0 3.0 - 4.5 8.5 - 10.0 13.5 - 15.0	Concrete BDL BDL 90 40	.
13B5	0 - 1.5 1.5 - 3.0 3.0 - 4.5 8.5 - 10.0 13.5 - 15.0	Concrete BDL BDL BDL 2	.
13B6	0 - 1.5 1.5 - 3.0 3.0 - 4.5 8.5 - 10.0 13.5 - 15.0	Concrete BDL BDL 50 60	.

NOTE:

NS = Not Sampled
BDL = Below Instrument Detection Limit of 0.01 ppm
NSR = No Sample Retained in Split Spoon

TABLE 2.2 (Page 2 of 6)
SUMMARY OF HEADSPACE PID ANALYSIS
VOLUME III ADDENDUM REPORT OF
UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

SAMPLE LOCATION I.D. #	SAMPLE DEPTH (ft.)	PID READING (ppm)	SAMPLE SELECTED FOR LABORATORY ANALYSIS
13B7	0 - 1.5	Asphalt	.
	1.5 - 3.0	BDL	
	3.0 - 4.5	10	
	8.5 - 10.0	20	
	13.5 - 15.0	5	
13B8	NS		
13B9	0 - 1.5	BDL	.
	1.5 - 3.0	BDL	
	3.0 - 4.5	BDL	
	8.5 - 10.0	BDL	
	13.5 - 15.0	BDL	
13B10	0 - 1.5	Concrete	.
	1.5 - 3.0	BDL	
	3.0 - 4.5	BDL	
	8.5 - 10.0	BDL	
	13.5 - 15.0	BDL	
13GW9	0 - 1.5	Asphalt	.
	1.5 - 3.0	30	
	3.0 - 4.5	20	
	8.5 - 10.0	4	
	13.5 - 15.0	2	
	18.5 - 20.0	5	
13GW10	NS		
13GW11	0 - 1.5	Concrete	.
	1.5 - 3.0	BDL	
	3.0 - 4.5	BDL	
	8.5 - 10.0	110	
	13.5 - 15.0	40	

NOTE:

NS = Not Sampled
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NSR = No Sample Retained in Split Spoon

TABLE 2.2 (Page 3 of 6)
SUMMARY OF HEADSPACE PID ANALYSIS
VOLUME III ADDENDUM REPORT OF
UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

SAMPLE LOCATION I.D. #	SAMPLE DEPTH (ft.)	PID READING (ppm)	SAMPLE SELECTED FOR LABORATORY ANALYSIS
13GW12	0 - 1.5 1.5 - 3.0 3.0 - 4.5 8.5 - 10.0 13.5 - 15.0	Concrete BDL BDL BDL BDL	.
13GW13	0 - 1.5 1.5 - 3.0 3.0 - 4.5 8.5 - 10.0 13.5 - 15.0	Asphalt BDL BDL BDL BDL	.
13GW14	0 - 1.5 1.5 - 3.0 3.0 - 4.5 8.5 - 10.0 13.5 - 15.0	Asphalt BDL 20 70 60	.
13GW15	0 - 1.5 1.5 - 3.0 3.0 - 4.5 8.5 - 10.0 13.5 - 15.0	Concrete BDL BDL BDL BDL	.
13GW16	0 - 1.5 1.5 - 3.0 3.0 - 4.5 8.5 - 10.0 13.5 - 15.0	Concrete BDL BDL BDL BDL	.
13GW17	0 - 1.5 1.5 - 3.0 3.0 - 4.5 8.5 - 10.0 13.5 - 15.0	Concrete BDL BDL BDL BDL	.

NOTE:

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TABLE 2.2 (Page 4 of 6)
SUMMARY OF HEADSPACE PID ANALYSIS
VOLUME III ADDENDUM REPORT OF
UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
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CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

SAMPLE LOCATION I.D. #	SAMPLE DEPTH (ft.)	PID READING (ppm)	SAMPLE SELECTED FOR LABORATORY ANALYSIS
13GW18	0 - 1.5	Concrete	•
	1.5 - 3.0	BDL	
	3.0 - 4.5	BDL	
	8.5 - 10.0	BDL	
	13.5 - 15.0	BDL	
13GW19	0 - 1.5	Concrete	•
	1.5 - 3.0	BDL	
	3.0 - 4.5	BDL	
	8.5 - 10.0	BDL	
	13.5 - 15.0	BDL	
13GW20	0 - 1.5	Concrete	•
	1.5 - 3.0	BDL	
	3.0 - 4.5	BDL	
	8.5 - 10.0	BDL	
	13.5 - 15.0	BDL	
13GW21	0 - 1.5	Concrete	•
	1.5 - 3.0	BDL	
	3.0 - 4.5	BDL	
	8.5 - 10.0	BDL	
	13.5 - 15.0	BDL	
13GW22	0 - 1.5	Concrete	•
	1.5 - 3.0	BDL	
	3.0 - 4.5	BDL	
	8.5 - 10.0	3	
	13.5 - 15.0	16	
13GW23	0 - 1.5	Concrete	•
	1.5 - 3.0	BDL	
	3.0 - 4.5	BDL	
	8.5 - 10.0	30	
	13.5 - 15.0	20	

NOTE:

NS = Not Sampled
BDL = Below Instrument Detection Limit of 0.01 ppm
NSR = No Sample Retained in Split Spoon

TABLE 2.2 (Page 5 of 6)
SUMMARY OF HEADSPACE PID ANALYSIS
VOLUME III ADDENDUM REPORT OF
UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

SAMPLE LOCATION I.D. #	SAMPLE DEPTH (ft.)	PID READING (ppm)	SAMPLE SELECTED FOR LABORATORY ANALYSIS
13GW24	13.5 - 15.0	BDL	•
13GW25	0 - 1.5 1.5 - 3.0 3.0 - 4.5 8.5 - 10.0 13.5 - 15.0	Concrete BDL BDL BDL BDL	•
13GW26	0.0 - 1.5 1.5 - 3.0 3.0 - 4.5 8.5 - 10.0 13.5 - 15.0 18.5 - 20.0 23.5 - 25.0	Concrete BDL BDL 3 90 80 60	• •
13GW27	0.0 - 1.5 1.5 - 3.0 3.0 - 4.5 8.5 - 10.0 13.5 - 15.0	No PID Readings Collected	• •
13GW28	0.0 - 1.5 1.5 - 3.0 3.0 - 4.5 8.5 - 10.0 13.5 - 15.0 18.5 - 20.0 23.5 - 25.0 28.5 - 30.0 33.5 - 35.0 38.5 - 40.0	BDL BDL BDL BDL 4 2 NSR NSR BDL BDL	• •

NOTE:

NS = Not Sampled
BDL = Below Instrument Detection Limit of 0.01 ppm
NSR = No Sample Retained in Split Spoon

TABLE 2.2 (Page 6 of 6)
SUMMARY OF HEADSPACE PID ANALYSIS
VOLUME III ADDENDUM REPORT OF
UNDERGROUND FUEL INVESTIGATION
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CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

SAMPLE LOCATION I.D. #	SAMPLE DEPTH (ft.)	PID READING (ppm)	SAMPLE SELECTED FOR LABORATORY ANALYSIS
13GW29	0.0 - 1.5	BDL	• •
	1.5 - 3.0	BDL	
	3.0 - 4.5	BDL	
	8.5 - 10.0	50	
	13.5 - 15.0	110	
	18.5 - 20.0	20	
	23.5 - 25.0	NSR	
	28.5 - 30.0	NSR	
	33.5 - 35.0	BDL	
	38.5 - 40.0	BDL	
	43.5 - 45.0	BDL	

NOTE:

NS = Not Sampled
BDL = Below Instrument Detection Limit of 0.01 ppm
NSR = No Sample Retained in Split Spoon

TABLE 2.3 (Page 1 of 3)
SUMMARY OF LABORATORY ANALYTICAL RESULTS
SOIL SAMPLES
VOLUME III ADDENDUM REPORT OF UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

SAMPLE LOCATION	SAMPLE DATE	SAMPLE DEPTH (ft)	LABORATORY RESULTS						
			TPH IDENTIFIED AS GASOLINE (mg/kg) ⁽¹⁾	TPH IDENTIFIED AS DIESEL (mg/kg) ⁽²⁾	KEROSENE (mg/kg) ⁽³⁾	TOX (mg/kg) ⁽⁴⁾	IGNITABILITY (Degrees F)	LEAD (ug/L)	pH
1381	10/11/90	8.5-10.0	680	--	1400	6	> 200	39	--
1382	10/11/90	8.5-10.0	ND	--	130	6	> 200	ND	--
1383	10/12/90	8.5-10.0	ND	--	37000	6	> 200	62	--
1384	10/12/90	8.5-10.0	ND	--	800	8	> 200	50	--
1385	10/12/90	13.5-15.0	ND	--		10	> 200	37	--
1386	10/12/90	13.5-15.0	1065	--	400	8	> 200	43	--
1387	10/15/90	3.0-4.5	ND	--	20	5	> 200	ND	--
1389	10/15/90	8.5-10.0	ND	--		10	> 200	ND	--
13810	10/12/90	8.5-10.0	ND	--		4	> 200	ND	--
13GW9	10/11/90	1.5-3.0	ND	--		9	> 200	ND	--
13GW11	10/24/90	8.5-10.0	ND	--	22000	19	> 200	ND	--
13GW12	10/30/90	13.5-15.0	ND	--		33	> 200	ND	--
13GW13	10/15/90	13.5-15.0	ND	--		9	> 200	ND	--

NOTE:

- ND Not Detected
 -- Not Analyzed
 (1) Total Petroleum Hydrocarbons according to EPA Method 5030 and GC/FID
 (2) Total Petroleum Hydrocarbons according to EPA Method 3550 and GC/FID
 (3) Kerosene qualitatively identified only
 (4) Total Organic Halides

TABLE 2.3 (Page 2 of 3)
SUMMARY OF LABORATORY ANALYTICAL RESULTS
SOIL SAMPLES
VOLUME III ADDENDUM REPORT OF UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

SAMPLE LOCATION	SAMPLE DATE	SAMPLE DEPTH (ft)	LABORATORY RESULTS						
			TPH IDENTIFIED AS GASOLINE (mg/kg) ⁽¹⁾	TPH IDENTIFIED AS DIESEL (mg/kg) ⁽²⁾	KEROSENE (mg/kg) ⁽³⁾	TOX (mg/kg) ⁽⁴⁾	IGNITABILITY (Degree F)	LEAD (ug/L)	pH
13GW14	10/16/90	8.5-10.0	1000	--	1500	35	> 200	65	--
13GW15	10/16/90	13.5-15.0	ND	--		44	> 200	ND	--
13GW16	10/16/90	13.5-15.0	ND	--		24	> 200	ND	--
13GW17	10/25/90	13.5-15.0	ND	--		18	> 200	ND	--
13GW18	10/29/90	13.5-5.0	ND	--		42	> 200	ND	--
13GW19	10/29/90	1.5-3.0	ND	--		12	> 200	ND	--
13GW20	10/29/90	13.5-15.0	ND	--		70	> 200	ND	--
13GW21	10/24/90	13.5-15.0	ND	--		ND	> 200	ND	--
13GW22	10/24/90	13.5-15.0	ND	--		81	> 200	ND	--
13GW23	10/29/90	8.5-10.0	ND	--	600	34	> 200	28	--
13GW24	10/26/90	13.5-15.0	ND	--		35	> 200	ND	--
13GW25	10/24/90	13.5-15.0	ND	--		60	> 200	ND	--
13GW26	12/04/91	13.5-15.0	0.6	ND	ND	--	> 200	ND	7.6

NOTE:

- ND Not Detected
-- Not Analyzed
(1) Total Petroleum Hydrocarbons according to EPA Method 5030 and GC/FID
(2) Total Petroleum Hydrocarbons according to EPA Method 3550 and GC/FID
(3) Kerosene qualitatively identified only
(4) Total Organic Halides

TABLE 2.3 (Page 3 of 3)
SUMMARY OF LABORATORY ANALYTICAL RESULTS
SOIL SAMPLES
VOLUME III ADDENDUM REPORT OF UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

SAMPLE LOCATION	SAMPLE DATE	SAMPLE DEPTH (ft)	LABORATORY RESULTS						
			TPH IDENTIFIED AS GASOLINE (mg/kg) ⁽¹⁾	TPH IDENTIFIED AS DIESEL (mg/kg) ⁽²⁾	KEROSENE (mg/kg) ⁽³⁾	TOX (mg/kg) ⁽⁴⁾	IGNITABILITY (Degrees F)	LEAD (ug/L)	pH
13GW26	12/04/91	18.5-20.0	ND	ND	ND	--	--	23	--
13GW27	11/22/91	1.5-3.0	ND	ND	ND	--	--	ND	--
13GW27	11/22/91	8.5-10.0	S	ND	ND	--	--	ND	--
13GW28	12/10/91	13.5-15.0	ND	ND	ND	--	--	ND	--
13GW28	12/10/91	18.5-20.0	ND	ND	ND	--	--	ND	--
13GW29	12/19/91	8.5-10.0	ND	220	ND	--	--	ND	--
13GW29	12/10/91	13.5-15.0	ND	2300	ND	--	--	ND	--

NOTE:

- ND Not Detected
-- Not Analyzed
(1) Total Petroleum Hydrocarbons according to EPA Method 5030 and GC/FID
(2) Total Petroleum Hydrocarbons according to EPA Method 3550 and GC/FID
(3) Kerosene qualitatively identified only
(4) Total Organic Halides

TABLE 2.4 (Page 1 of 5)
SUMMARY OF LABORATORY ANALYTICAL RESULTS*
GROUND WATER SAMPLES
VOLUME III ADDENDUM REPORT OF UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

PARAMETER	WELL #	13GW1	13GW2	13GW3	13GW4	13GW5	13GW6
	DATE SAMPLED	11/8/90	11/8/90	11/8/90	11/8/90	11/7/90	11/7/90
Acenaphthylene		--	6	--	--	--	--
Benzene		270	900	ND	ND	ND	25
Chlorobenzene		720	ND	ND	ND	ND	ND
Chloroform		ND	ND	ND	ND	ND	ND
Ethylbenzene		3900	200	280	580	ND	77
Fluorene		--	4	--	--	--	--
Lead		65	376	91	49	244	117
Methylene Chloride		ND	ND	ND	ND	3	296
Methylene Chloride (Lab Blank)		--	--	--	--	3	160
Naphthalene		--	43	--	--	--	--
Phenanthrene		--	0.4	--	--	--	--
Trichlorethene		ND	ND	ND	ND	ND	ND
Toluene		ND	ND	ND	ND	0.3	320
Xylenes (total)		4400	550	960	2300	0.9	340

NOTES:

- All results are ug/L.
- ND Not Detected; see laboratory reports for applicable detection limits.
- Sample not analyzed for this parameter.

TABLE 2.4 (Page 2 of 5)
SUMMARY OF LABORATORY ANALYTICAL RESULTS*
GROUND WATER SAMPLES
VOLUME III ADDENDUM REPORT OF UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

PARAMETER	WELL #	13GW7	13GW8	13GW9	13GW10	13GW11	13GW12
	DATE SAMPLED	11/7/90	11/8/90	11/7/90	11/6/90	11/6/90	11/7/90
Acenaphthylene		--	--	--	--	--	--
Benzene		ND	ND	190	42	2	0.4
Chlorobenzene		ND	ND	ND	ND	ND	ND
Chloroform		ND	ND	ND	ND	3	ND
Ethylbenzene		ND	ND	210	110	ND	ND
Fluorene		--	--	--	--	--	--
Lead		7	13	47	47	2	71
Methylene Chloride		5	ND	310	ND	ND	ND
Methylene Chloride (Lab Blank)		3	3.6	64	--	--	--
Naphthalene		--	--	--	--	--	--
Phenanthrene		--	--	--	--	--	--
Trichlorethene		1	8	ND	ND	ND	ND
Toluene		ND	ND	175	100	ND	0.3
Xylenes (total)		ND	ND	ND	450	0.8	1

NOTES:

- * All results are ug/L.
- ND Not Detected; see laboratory reports for applicable detection limits.
- Sample not analyzed for this parameter.

TABLE 2.4 (Page 3 of 5)
SUMMARY OF LABORATORY ANALYTICAL RESULTS*
GROUND WATER SAMPLES
VOLUME III ADDENDUM REPORT OF UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

PARAMETER	WELL #	13GW13	13GW14	13GW15	13GW16	13GW17	13GW18
	DATE SAMPLED	11/8/90	11/7/90	11/7/90	11/7/90	11/7/90	11/7/90
Acenaphthylene		--	--	--	--	--	--
Benzene		ND	3500	ND	ND	2	ND
Chlorobenzene		ND	ND	ND	ND	ND	ND
Chloroform		ND	ND	ND	ND	ND	ND
Ethylbenzene		ND	1850	ND	ND	ND	ND
Fluorene		--	--	--	--	--	--
Lead		21	3200	34	38	45	168
Methylene Chloride		13	6000	ND	ND	ND	5
Methylene Chloride (Lab Blank)		10	800	--	--	--	3
Naphthalene		--	--	--	--	--	--
Phenanthrene		--	--	--	--	--	--
Trichlorethene		ND	ND	ND	ND	ND	ND
Toluene		0.7	8300	ND	ND	0.4	ND
Xylenes (total)		ND	7300	0.7	0.7	3	0.8

NOTES:

- * All results are ug/L.
- ND Not Detected; see laboratory reports for applicable detection limits.
- Sample not analyzed for this parameter.

TABLE 2.4 (Page 4 of 5)
SUMMARY OF LABORATORY ANALYTICAL RESULTS*
GROUND WATER SAMPLES
VOLUME III ADDENDUM REPORT OF UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

PARAMETER	WELL #	13GW19	13GW20	13GW21	13GW22	13GW23	13GW24
	DATE SAMPLED	11/7/90	11/7/90	11/7/90	11/7/90	11/7/90	11/7/90
Acenaphthylene		--	--	--	--	--	--
Benzene		0.9	ND	ND	620	0.6	54
Chlorobenzene		ND	ND	ND	ND	ND	ND
Chloroform		ND	ND	ND	ND	2	ND
Ethylbenzene		ND	ND	ND	ND	0.9	1
Fluorene		--	--	--	--	--	--
Lead		64	24	38	39	152	56
Methylene Chloride		ND	ND	ND	ND	ND	14
Methylene Chloride (Lab Blank)		--	--	--	--	--	3
Naphthalene		--	--	--	--	--	--
Phenanthrene		--	--	--	--	--	--
Trichlorethene		1	ND	ND	ND	ND	ND
Toluene		ND	ND	ND	ND	0.8	2
Xylenes (total)		0.8	ND	0.9	260	4	5

NOTES:

- All results are ug/L.
- ND Not Detected; see laboratory reports for applicable detection limits.
- Sample not analyzed for this parameter.

TABLE 2.4 (Page 5 of 5)
SUMMARY OF LABORATORY ANALYTICAL RESULTS*
GROUND WATER SAMPLES
VOLUME III ADDENDUM REPORT OF UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

PARAMETER	WELL #	13GW25	13GW26	13GW27	13GW28	13GW29	NC GROUND-WATER STANDARD (ug/l)
	DATE SAMPLED	11/7/90	12/1/91	12/19/91	12/19/91	12/19/91	
Acenaphthylene		--	--	--	--	--	Detection Limit
Benzene		4	38	8	7	560	1
Chlorobenzene		ND	ND	ND	ND	ND	300
Chloroform		ND	--	--	--	--	0.19
Ethylbenzene		ND	33	0.9	0.6	ND	29
Fluorene		--	--	--	--	--	Detection Limit
Lead		39	100	140	ND	ND	50
Methylene Chloride		ND	--	--	--	--	5
Methylene Chloride (Lab Blank)		--	--	--	--	--	5
Naphthalene		--	--	--	--	--	Detection Limit
Phenanthrene		--	--	--	--	--	Detection Limit
Trichlorethene		ND	--	--	--	--	2.8
Toluene		ND	9	ND	ND	ND	1000
Xylenes (total)		2	110	3	ND	140	400

NOTES:

- * All results are ug/L.
- ND Not Detected; see laboratory reports for applicable detection limits.
- Sample not analyzed for this parameter.

TABLE 3.1
SUMMARY OF AQUIFER PARAMETER DETERMINATIONS
VOLUME III ADDENDUM REPORT OF UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

AQUIFER PARAMETER	OBSERVATION WELL NUMBER			
	13GW30 ⁽¹⁾	13GW31 ⁽¹⁾	13GW28 ⁽²⁾	13GW29 ⁽²⁾
I. Transmissivity (gpd/ft) by:				
a) Distance-Drawdown	2,600	--	--	--
b) Time-Drawdown	3,300	8,400	--	--
c) Type Curve Matching	2,500	7,200	--	--
II. Specific Storage by:				
a) Distance-Drawdown	0.009	--	--	--
b) Time-Drawdown	0.00088	0.00057	--	--
c) Type Curve Matching	0.001	0.0008	--	--
III. Hydraulic Conductivity (ft/day) by:				
a) Distance-Drawdown	9.9	9.9	--	--
b) Time-Drawdown	12.5	32	--	--
c) Type Curve Matching	9.5	27.5	--	--
d) Grain Size Analysis	--	--	26/33	15

NOTES:

- (1) Wells 13GW30 and 13GW31 are pumping test observation wells
(2) Wells 13GW28 and 13GW29 results are from grain size analyses

TABLE 3.2
SUMMARY OF VERTICAL HYDRAULIC GRADIENT DETERMINATIONS
VOLUME III ADDENDUM REPORT OF UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT
TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA
LAW ENGINEERING JOB NO. 475-07174-04

	WELL PAIR			
	13GW24	13GW28	13GW10	13GW11
TOCE (ft.)	123.42	123.34	124.47	124.58
Mid-Screen Depth (ft.)	12.50	39.50	12.50	37.50
Mid-Screen Elevation (ft.)	110.92	83.84	111.97	87.06
SWLE (ft.)	12.48	12.49	10.95	10.65
ΔSWLE (ft.)	-0.01		+0.30	
ΔMid-Screen Elevation (ft.)	27.08		24.91	
Vertical Gradient	-0.00037		+0.012	

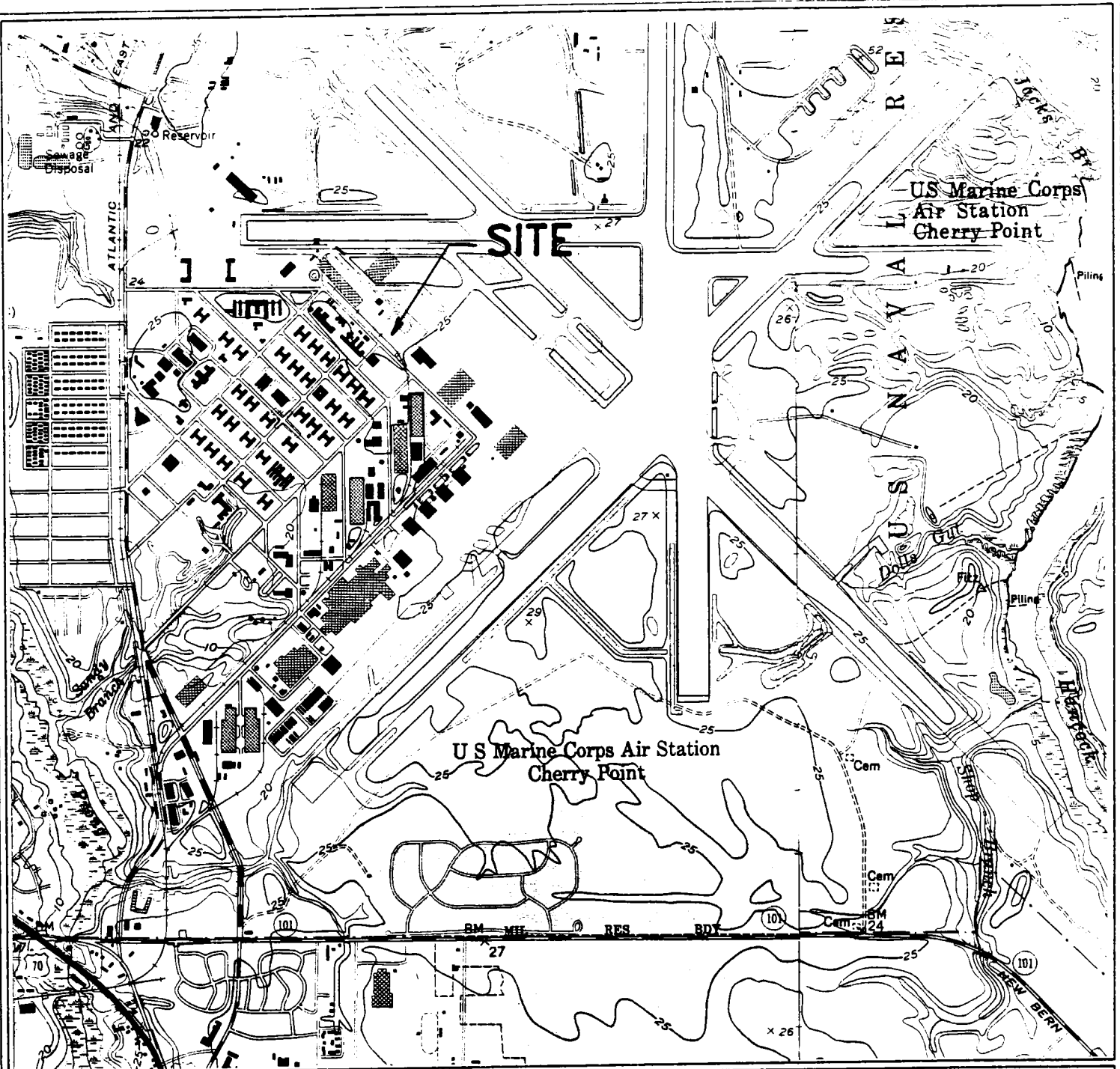
NOTES:

TOCE Top of Casing Elevation

SWLE Static Water Level Elevation

Negative gradient indicates upward movement

Positive gradient indicates downward movement



NORTH

HAVELOCK, N.C.
34078-H8-TF-024

CHERRY POINT, N.C.
34078-H7-TF-024



QUADRANGLE LOCATION



QUADRANGLE LOCATION

1949

PHOTOREVISED 1983
DMA 5653 IV NW-SERIES V842

1949

PHOTOREVISED 1983
DMA 5653 IV NE-SERIES V842

NOTE: SITE LOCATIONS ARE APPROXIMATE.

CONTOUR INTERVAL 5 FEET
GRAPHIC SCALE FEET

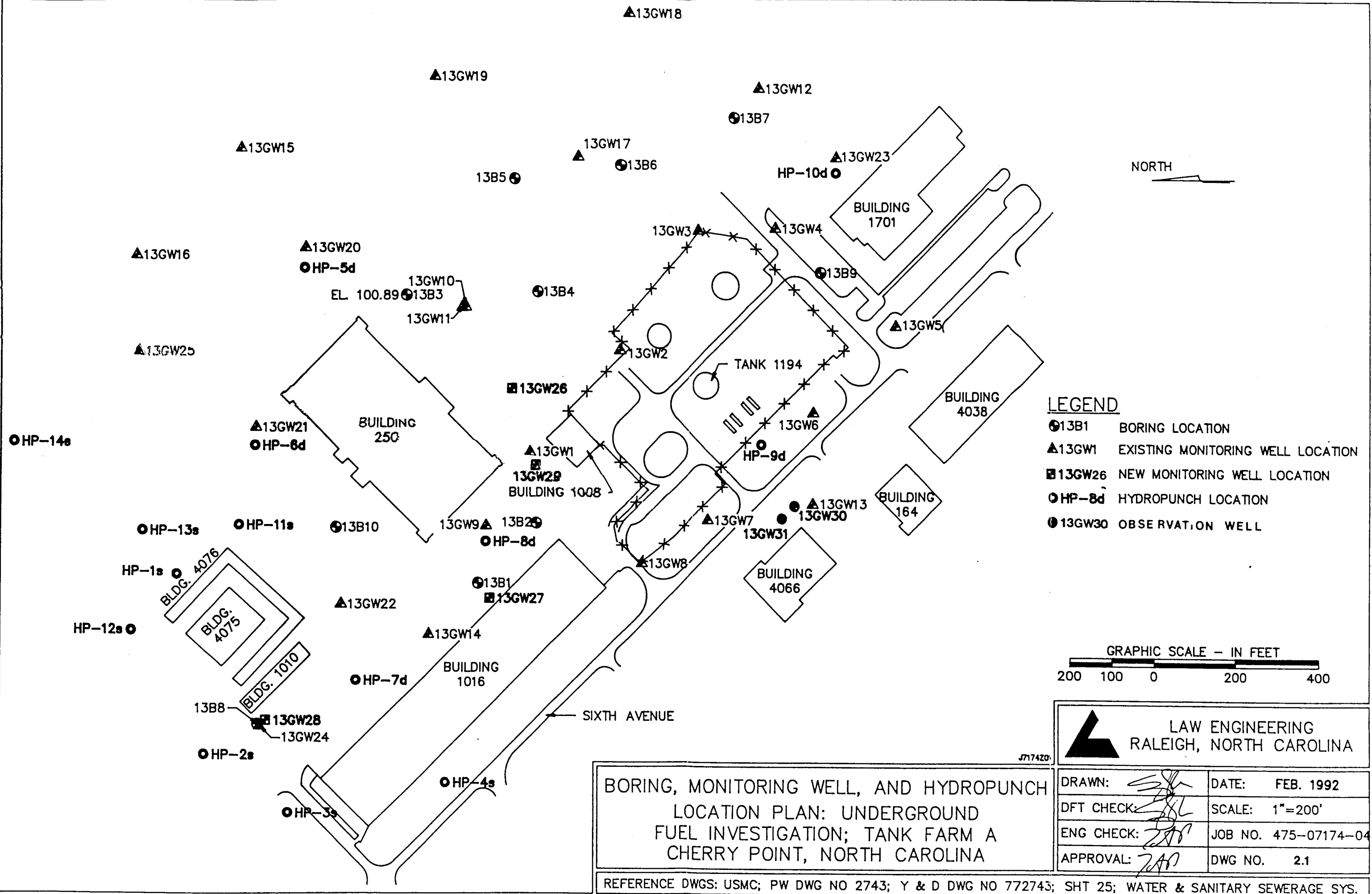
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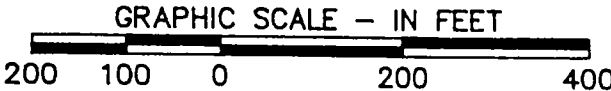
LAW ENGINEERING
RALEIGH, NORTH CAROLINA

GENERAL LOCATION
UNDERGROUND FUEL INVESTIGATION
TANK FARM A
CHERRY POINT, NORTH CAROLINA

DRAWN: <i>[Signature]</i>	DATE: JAN. 1992
DFT CHECK: <i>[Signature]</i>	SCALE: 1:24000
ENG CHECK: <i>[Signature]</i>	JOB: 475-07174-04
APPROVAL: <i>[Signature]</i>	DWG: 1.1



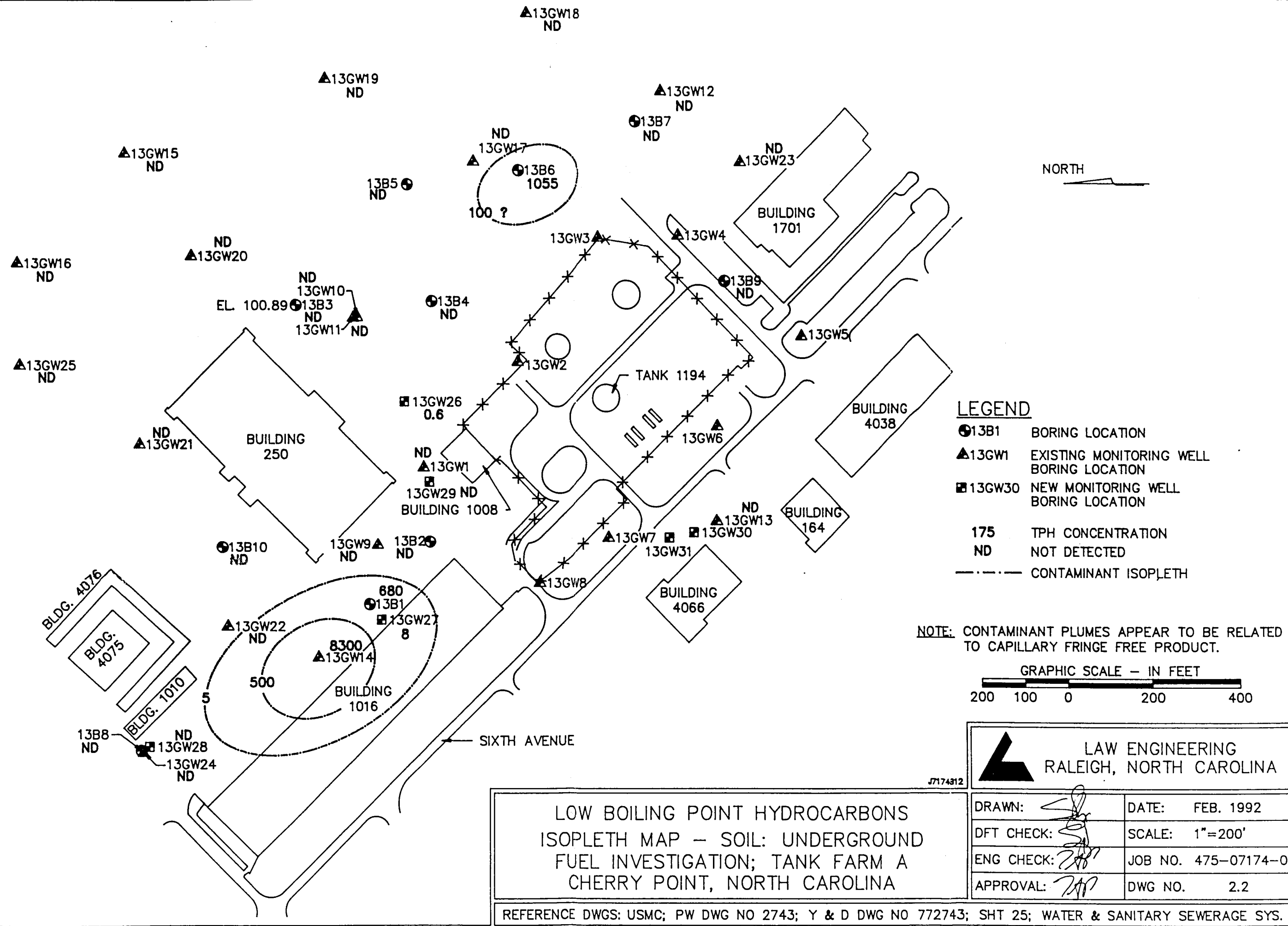
- LEGEND**
- 13B1 BORING LOCATION
 - ▲ 13GW1 EXISTING MONITORING WELL LOCATION
 - 13GW26 NEW MONITORING WELL LOCATION
 - HP-8d HYDROPUNCH LOCATION
 - 13GW30 OBSERVATION WELL



LAW ENGINEERING RALEIGH, NORTH CAROLINA	
DRAWN: <i>[Signature]</i>	DATE: FEB. 1992
DFT CHECK: <i>[Signature]</i>	SCALE: 1"=200'
ENG CHECK: <i>[Signature]</i>	JOB NO. 475-07174-04
APPROVAL: <i>[Signature]</i>	DWG NO. 2.1

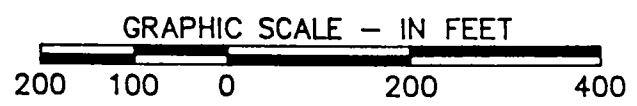
BORING, MONITORING WELL, AND HYDROPUNCH
LOCATION PLAN: UNDERGROUND
FUEL INVESTIGATION; TANK FARM A
CHERRY POINT, NORTH CAROLINA


REFERENCE DWGS: USMC; PW DWG NO 2743; Y & D DWG NO 772743; SHT 25; WATER & SANITARY SEWERAGE SYS.



- LEGEND**
- 13B1 BORING LOCATION
 - ▲ 13GW1 EXISTING MONITORING WELL BORING LOCATION
 - 13GW30 NEW MONITORING WELL BORING LOCATION
 - 175 TPH CONCENTRATION
 - ND NOT DETECTED
 - CONTAMINANT ISOPLETH

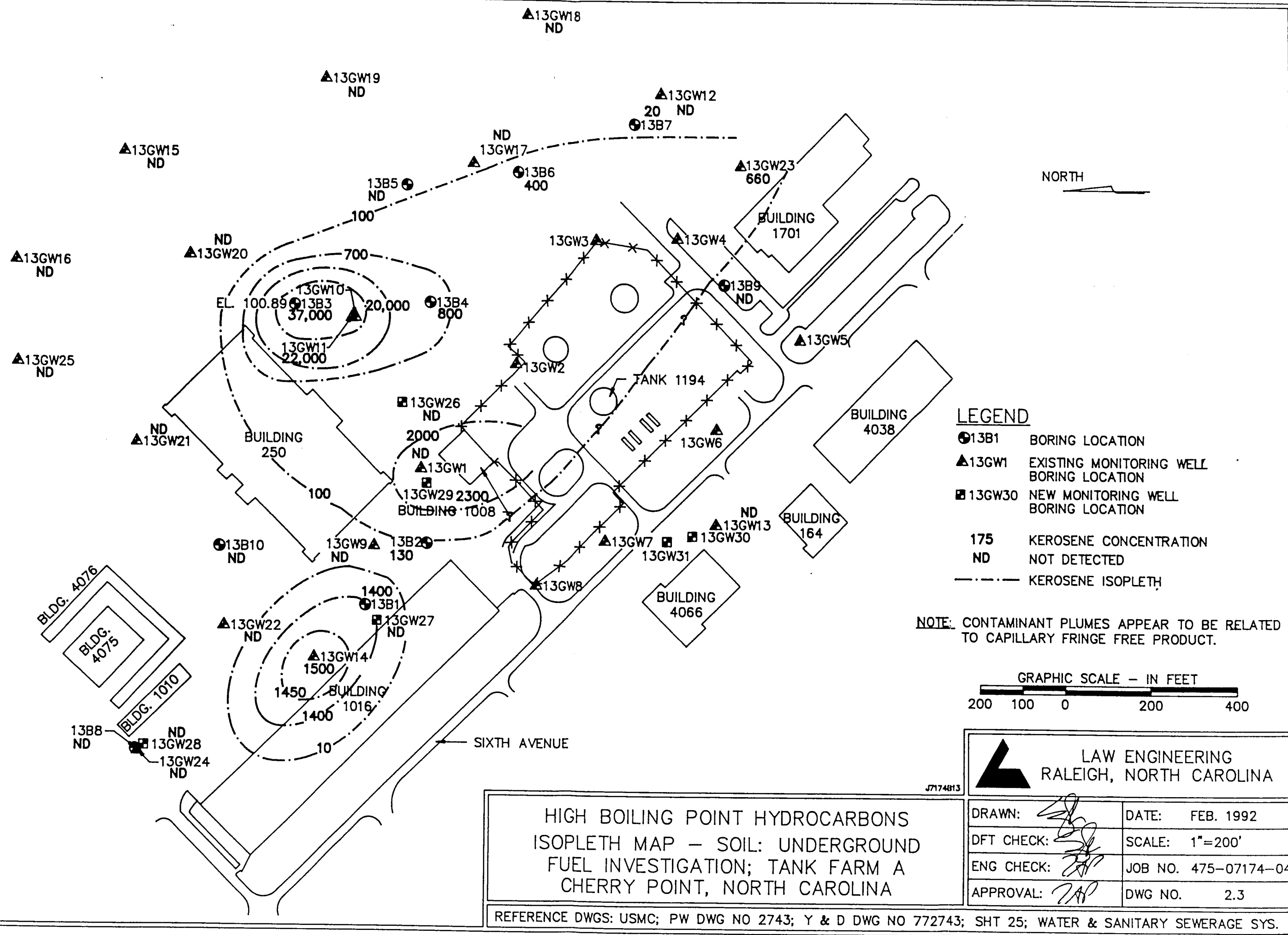
NOTE: CONTAMINANT PLUMES APPEAR TO BE RELATED TO CAPILLARY FRINGE FREE PRODUCT.



 LAW ENGINEERING RALEIGH, NORTH CAROLINA	
DRAWN: <i>[Signature]</i>	DATE: FEB. 1992
DFT CHECK: <i>[Signature]</i>	SCALE: 1"=200'
ENG CHECK: <i>[Signature]</i>	JOB NO. 475-07174-04
APPROVAL: <i>[Signature]</i>	DWG NO. 2.2

LOW BOILING POINT HYDROCARBONS
ISOPLETH MAP - SOIL: UNDERGROUND
FUEL INVESTIGATION; TANK FARM A
CHERRY POINT, NORTH CAROLINA

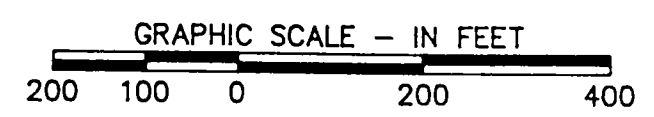
REFERENCE DWGS: USMC; PW DWG NO 2743; Y & D DWG NO 772743; SHT 25; WATER & SANITARY SEWERAGE SYS.




LEGEND

- 13B1 BORING LOCATION
- ▲ 13GW1 EXISTING MONITORING WELL BORING LOCATION
- 13GW30 NEW MONITORING WELL BORING LOCATION
- 175 KEROSENE CONCENTRATION
- ND NOT DETECTED
- KEROSENE ISOPLETH

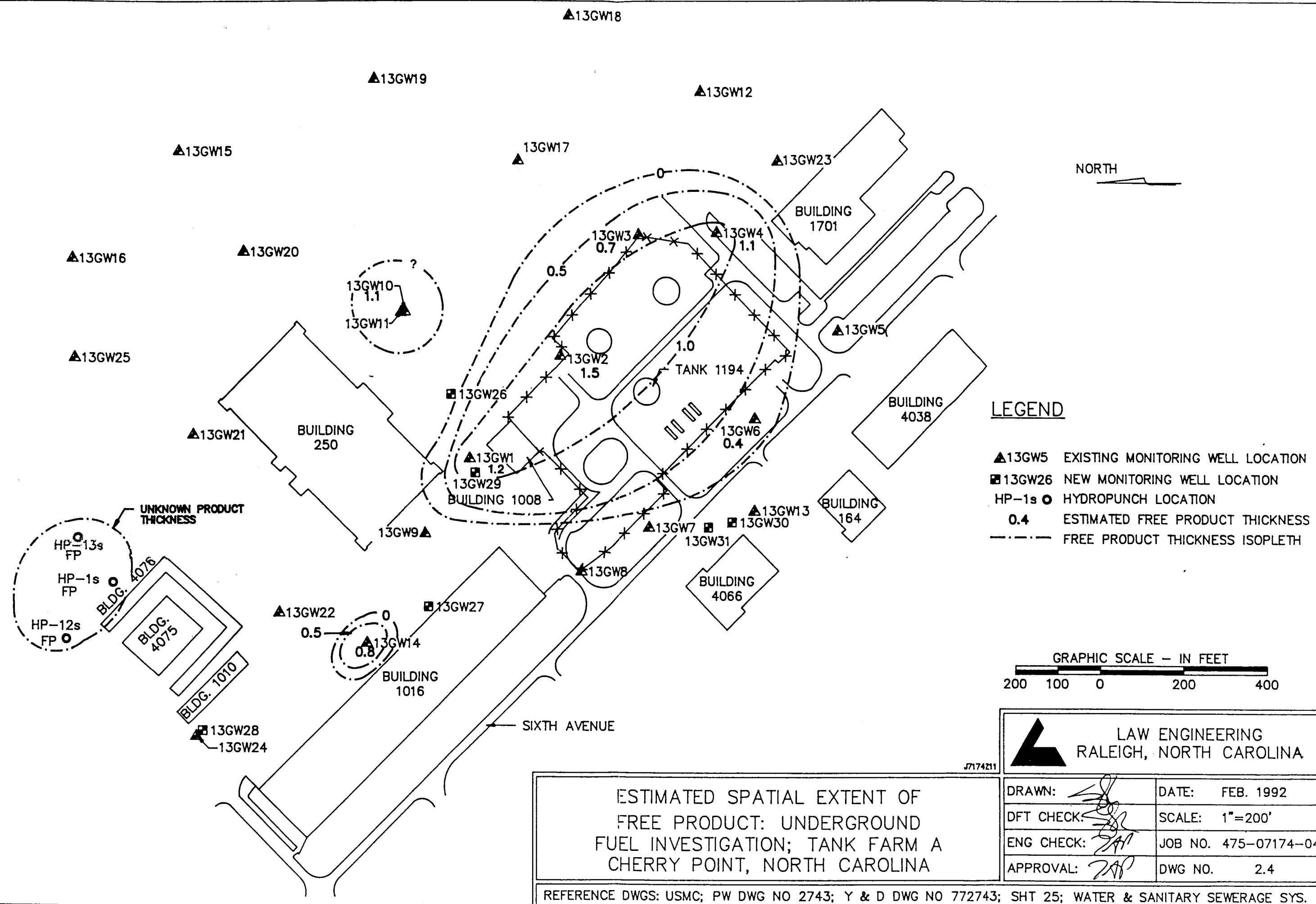
NOTE: CONTAMINANT PLUMES APPEAR TO BE RELATED TO CAPILLARY FRINGE FREE PRODUCT.

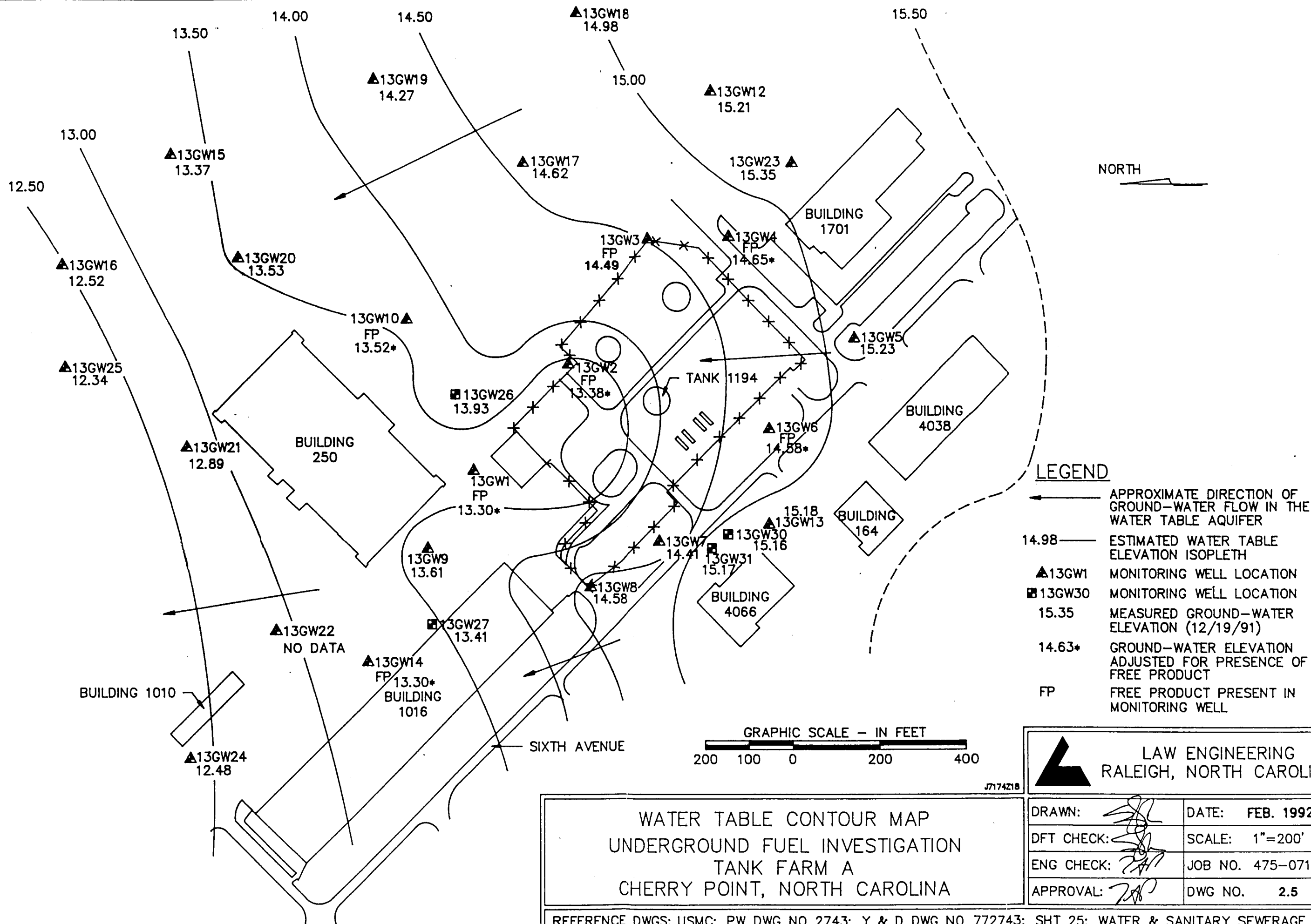


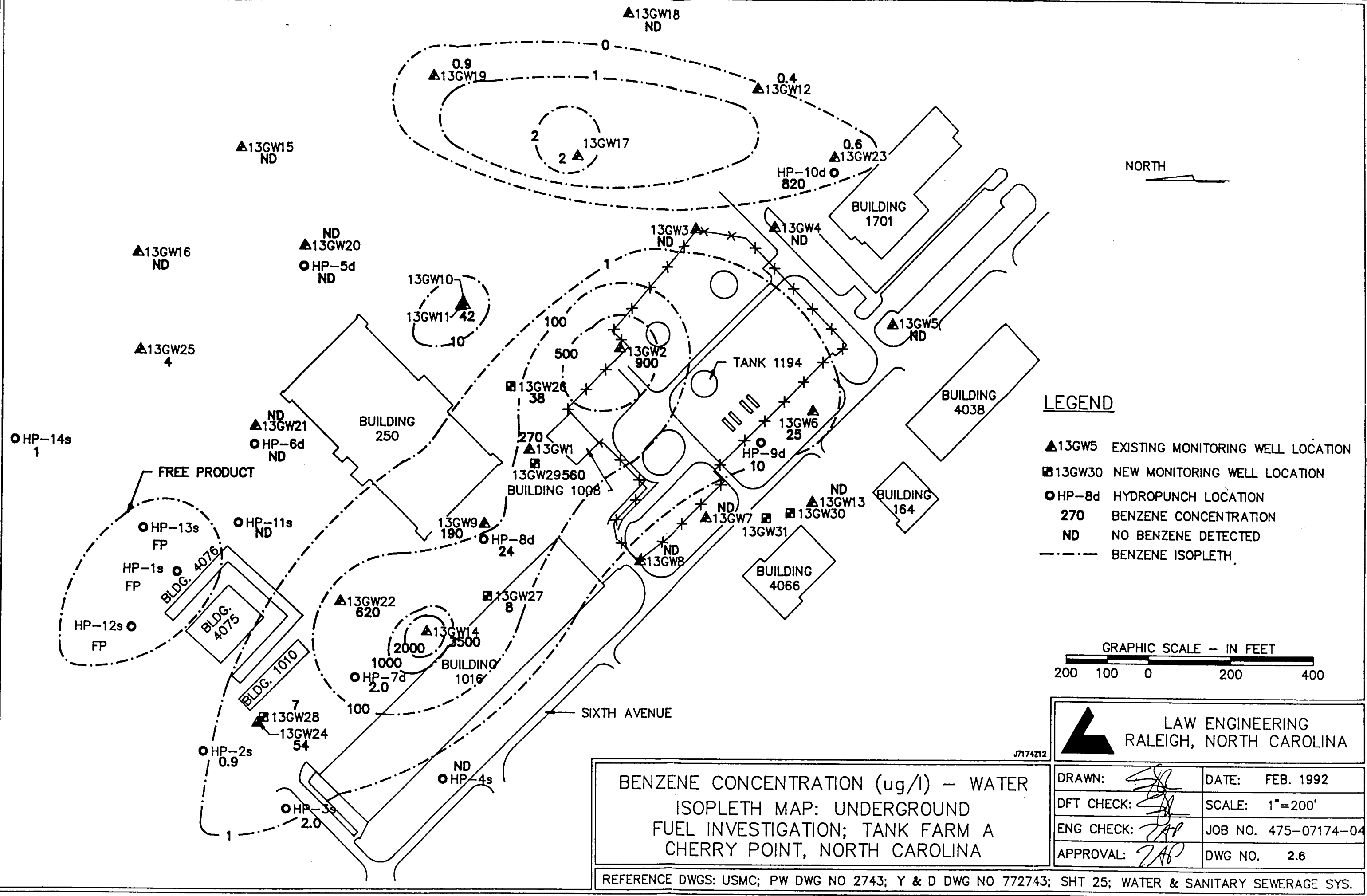
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APPROVAL: <i>[Signature]</i>	DWG NO. 2.3

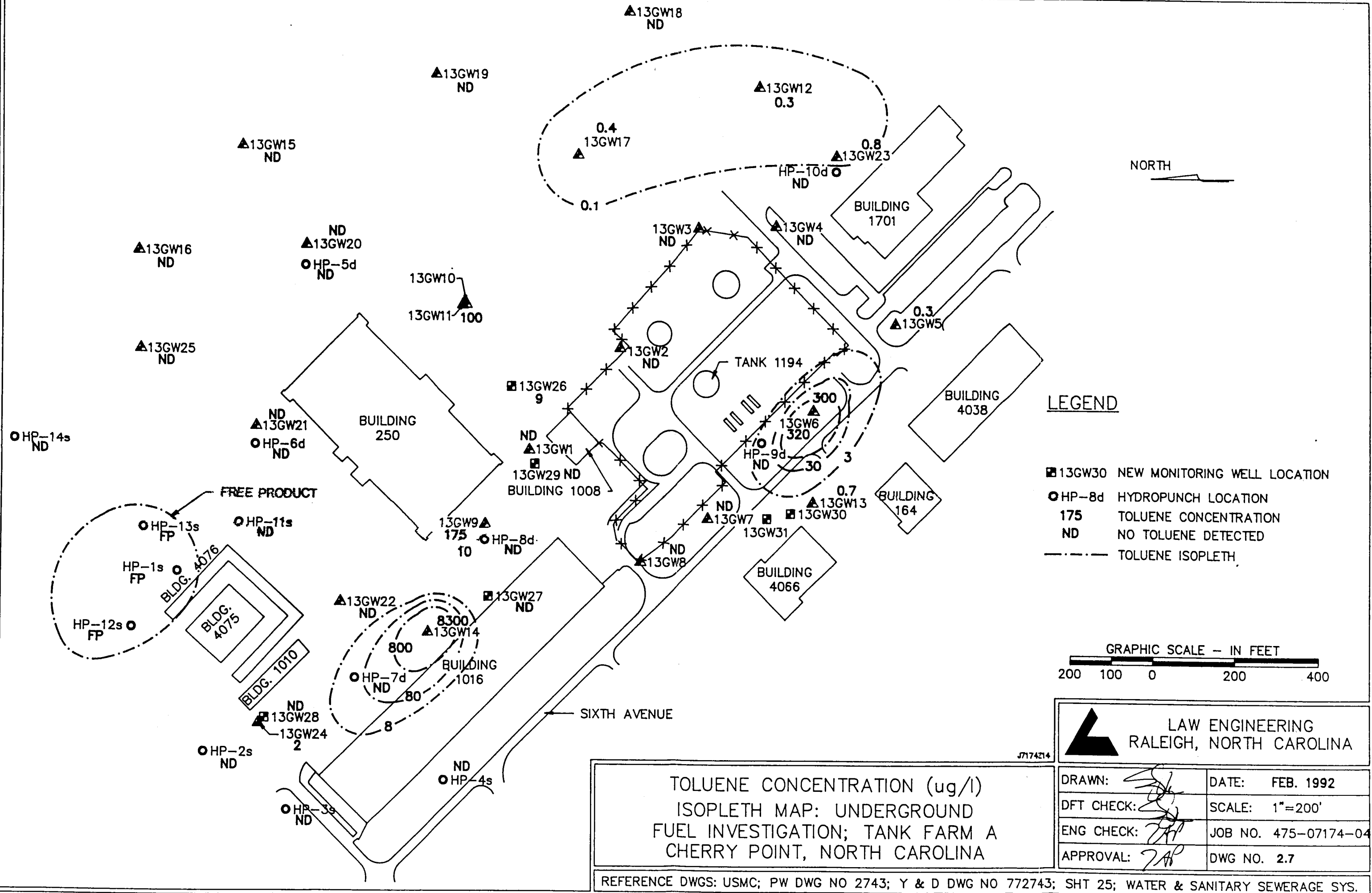
HIGH BOILING POINT HYDROCARBONS
 ISOPLETH MAP - SOIL: UNDERGROUND
 FUEL INVESTIGATION; TANK FARM A
 CHERRY POINT, NORTH CAROLINA

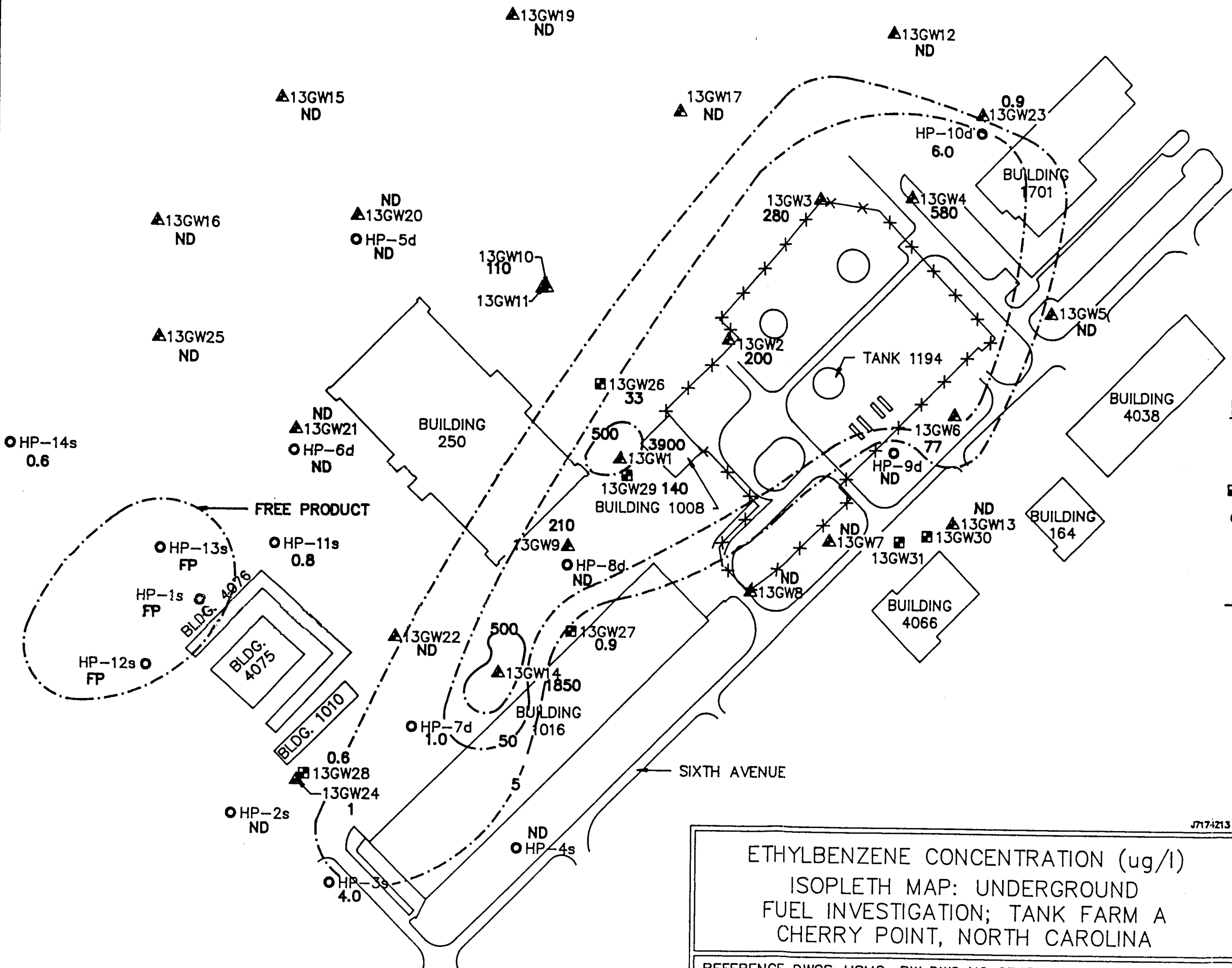
REFERENCE DWGS: USMC; PW DWG NO 2743; Y & D DWG NO 772743; SHT 25; WATER & SANITARY SEWERAGE SYS.





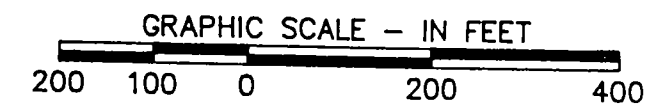







LEGEND

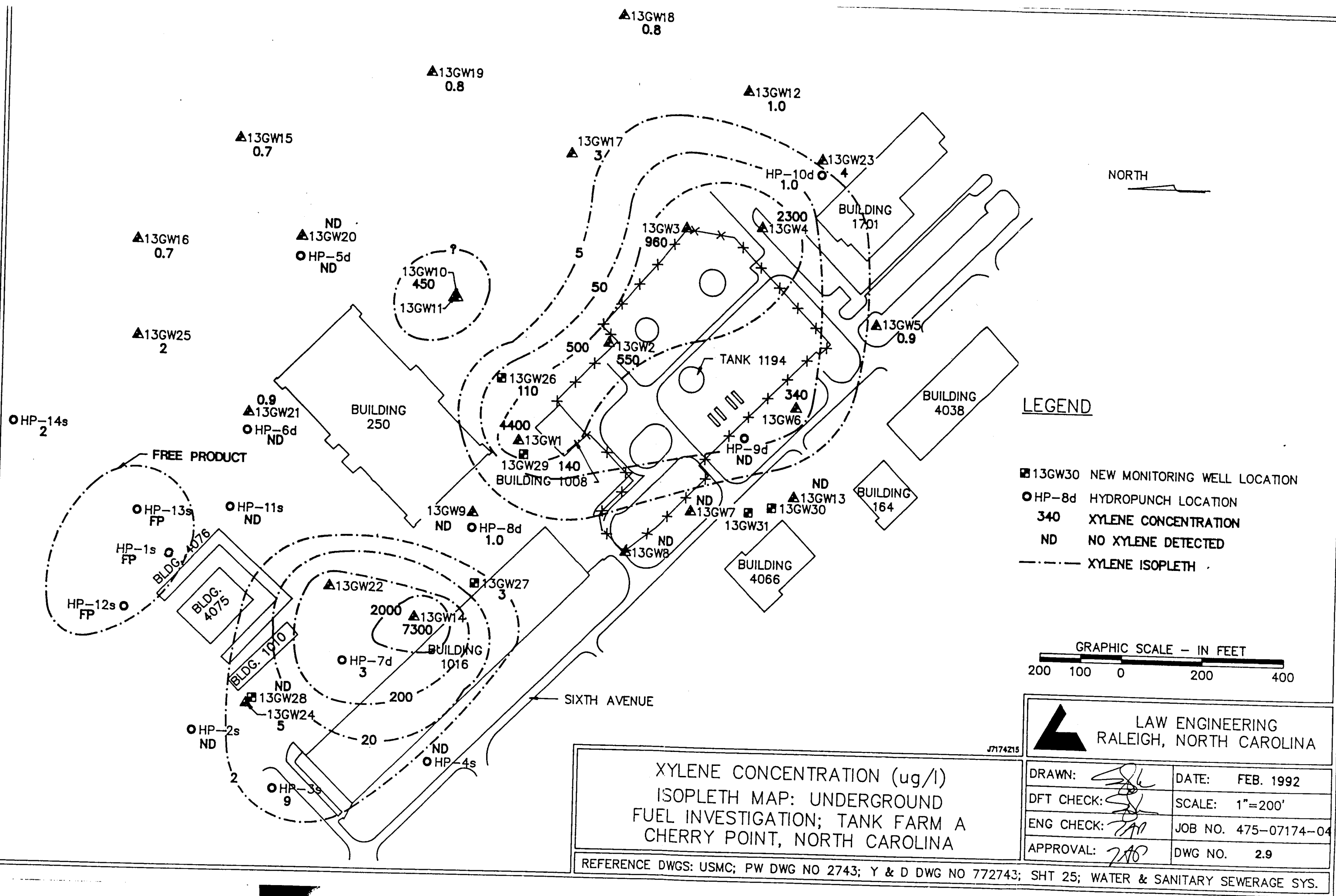
- 13GW30 NEW MONITORING WELL LOCATION
- HP-8d HYDROPUNCH LOCATION
- 1850 ETHYLBENZENE CONCENTRATION
- ND NO ETHYLBENZENE DETECTED
- ETHYLBENZENE ISOPLETH

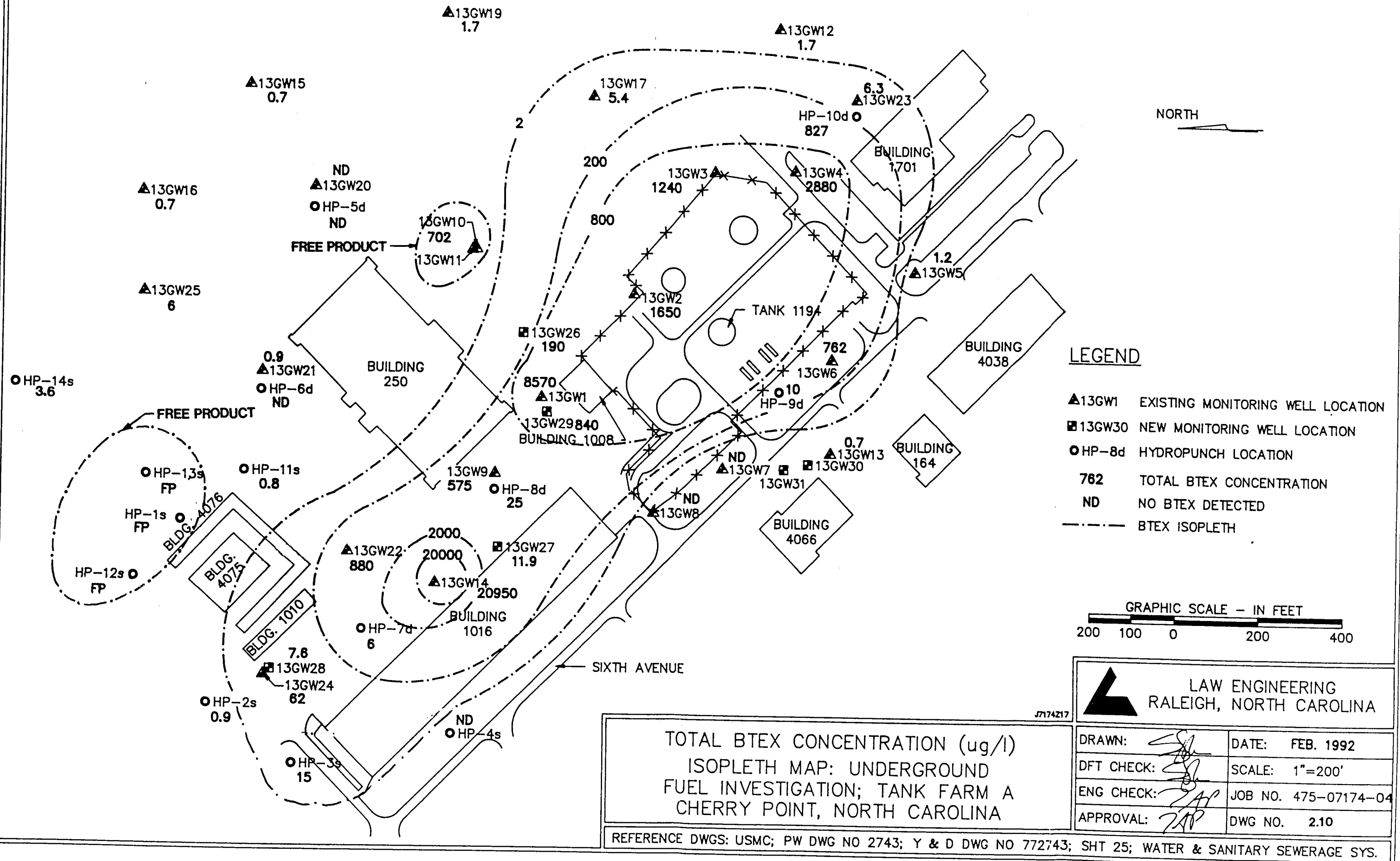


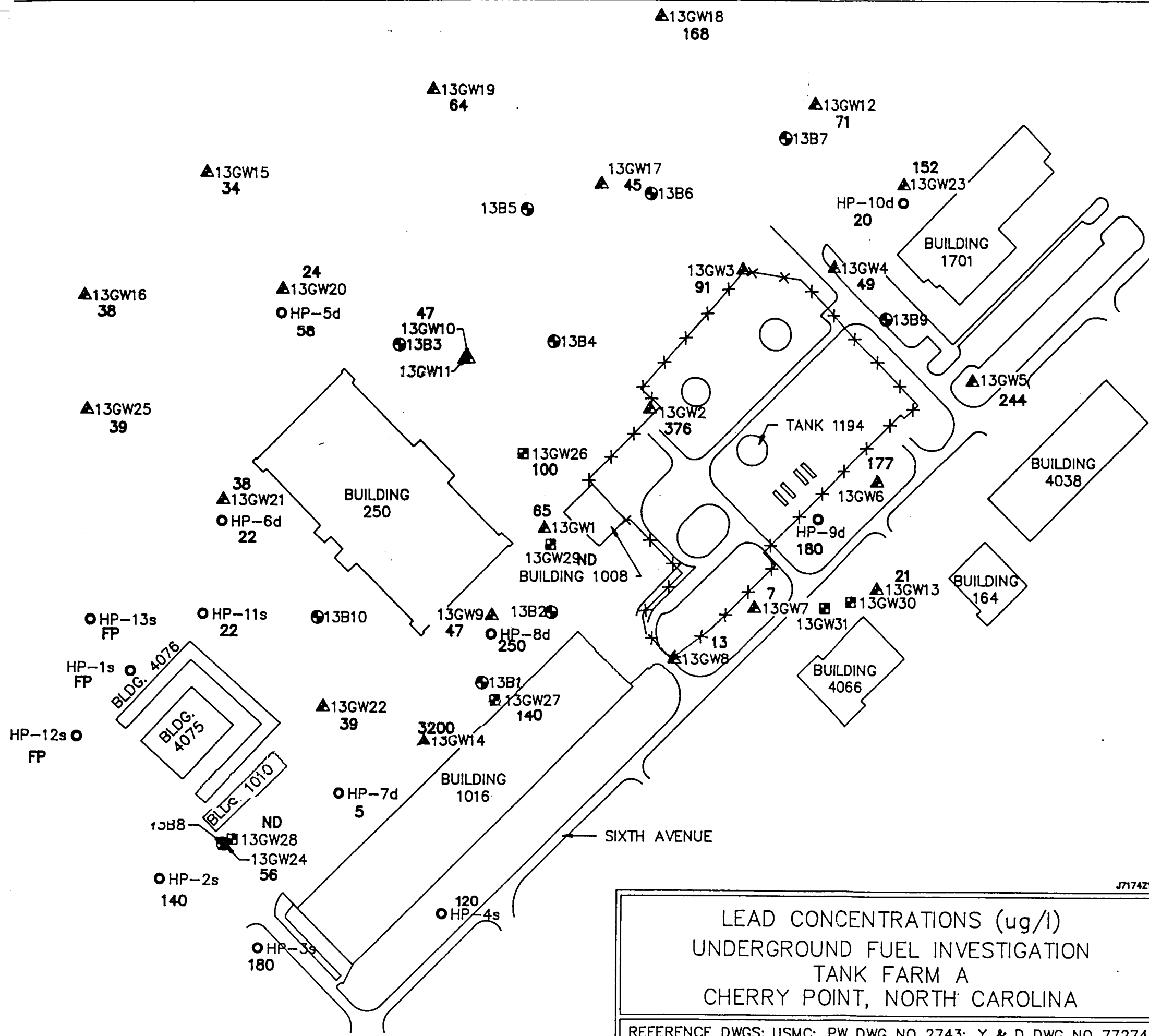
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DFT CHECK: <i>ESL</i>	SCALE: 1"=200'
ENG CHECK: <i>ZAP</i>	JOB NO. 475-07174-04
APPROVAL: <i>ZAP</i>	DWG NO. 2.8

ETHYLBENZENE CONCENTRATION (ug/l)
 ISOPLETH MAP: UNDERGROUND
 FUEL INVESTIGATION; TANK FARM A
 CHERRY POINT, NORTH CAROLINA

REFERENCE DWGS: USMC; PW DWG NO 2743; Y & D DWG NO 772743; SHT 25; WATER & SANITARY SEWERAGE SYS.

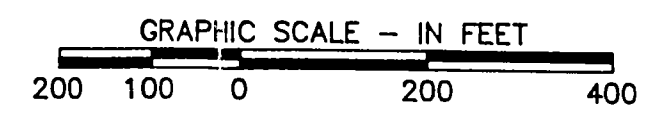






LEGEND

- 13B1 BORING LOCATION
- ▲ 13GW1 EXISTING MONITORING WELL LOCATION
- 13GW30 NEW MONITORING WELL LOCATION
- HP-8d HYDROPUNCH LOCATION
- 250 LEAD CONCENTRATION
- ND NO LEAD DETECTED



LAW ENGINEERING
RALEIGH, NORTH CAROLINA

LEAD CONCENTRATIONS (ug/l)
UNDERGROUND FUEL INVESTIGATION
TANK FARM A
CHERRY POINT, NORTH CAROLINA

DRAWN: <i>[Signature]</i>	DATE: FEB. 1992
DFT CHECK: <i>[Signature]</i>	SCALE: 1"=200'
ENG CHECK: <i>[Signature]</i>	JOB NO. 475-07174-04
APPROVAL: <i>[Signature]</i>	DWG NO. 2.11

REFERENCE DWGS: USMC; PW DWG NO 2743; Y & D DWG NO 772743; SHT 25; WATER & SANITARY SEWERAGE SYS.

**VOLUME III ADDENDUM REPORT
UNDERGROUND FUEL INVESTIGATION
COMPREHENSIVE SITE ASSESSMENT**

APPENDICES

**TANK FARM A
MARINE CORPS AIR STATION
CHERRY POINT, NORTH CAROLINA**

June 12, 1992

Law Engineering Job No. 475-07174-04

**Law Engineering, Inc.
Raleigh, North Carolina**



APPENDIX A

ADDITIONAL SITE ASSESSMENT AND CORRECTIVE ACTION WORKPLAN

**ADDITIONAL SITE ASSESSMENT
AND CORRECTIVE ACTION WORKPLAN**

**UNDERGROUND FUEL INVESTIGATION
TANK FARM A
MARINE CORPS AIR BASE
CHERRY POINT, NORTH CAROLINA**

**Issued: November 4, 1991
Law Engineering Job No: 475-07174-04**

**Law Engineering, Inc.
Raleigh, North Carolina**

November 4, 1991

Commander
Naval Facilities Engineering Command
Atlantic Division
Norfolk, Virginia 23511-6287

Attention: Code 1821, Mr. Trueman Seamans
Engineer-in-Charge

Subject: **UNDERGROUND FUEL INVESTIGATION ADDITIONAL
SITE ASSESSMENT AND CAP WORKPLAN
MARINE CORPS AIR STATION
TANK FARM A
CHERRY POINT, NORTH CAROLINA
CONTRACT NO. N62470-90-D-7625
LAW ENGINEERING JOB NO. 475-07174-04**

Dear Mr. Seamans:

Please find enclosed three copies of the above referenced Workplan document. This document covers those tasks designed to further identify and delineate subsurface petroleum fuel contamination and prepare a Corrective Action Plan for the Cherry Point Tank Farm A.

Please review the enclosed document and contact us regarding any questions or comments. Also note that we plan to begin field activities on November 12, 1991.

Law Engineering appreciates the opportunity to continue to provide services to you and LANTDIV on your environmental projects.

I look forward to hearing from you soon.

Sincerely,

LAW ENGINEERING, INC.

Thomas A. Proctor, P.G.
Project Geologist

W. Douglass Dixon, P.E.
Principal Engineer

TAP/WDD/bro

ENCLOSURES

cc: Mr. Mahlon Yokley, MCAS Cherry Point

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DRAWINGS

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3.1.2	Water Table Contour Map
3.1.3	Hydrocarbon Plume Map
3.1.4	Free Product Extent
4.1.1	Proposed Hydropunch and Monitoring Well Location Map
7.1.1	Project Schedule

APPENDIX A - Health and Safety Plan

1.0 INTRODUCTION

The purpose of this Additional Site Assessment and Corrective Action Workplan (Workplan) is to serve as a guidance document for performing additional work tasks to complete the determination of the magnitude and extent of free product accumulation and groundwater contamination at the Cherry Point Tank Farm A Facility and develop a Corrective Action Plan (CAP) for site remediation. This Workplan was prepared in accordance with the Scope of Work (SOW) developed by the Naval Facilities Engineering Command and requirements listed as Tasks I through IX of the draft document entitled "Comprehensive Site Assessments at LUST Release Sites: Basic Tasks and Minimal Elements" prepared by the Groundwater Section of the North Carolina Department of Environment, Health and Natural Resources (NCDEHNR). The objective of the additional assessment, in conjunction with the previously conducted assessment activities, is to provide sufficient data to meet the requirements of Sections 280.63 and 280.65 of 40 CFR Part 280, Federal Technical Standards for Underground Storage Tanks. The CAP will be prepared in order to meet the requirements of Section 280.66 of 40 CFR Part 280.

2.0 PREVIOUS INVESTIGATIONS

2.1 NUS Corporation Assessment Activities

In order to provide information regarding subsurface conditions in the vicinity of Tank Farm A, NUS Corporation (NUS) drilled fifteen soil borings and installed eight monitoring wells in December, 1984. A review of the data obtained during this initial investigation indicated that shallow soil and ground water contamination by petroleum-fuel related hydrocarbons was present in the vicinity of and hydraulically downgradient of the Tank Farm.

2.2 Law Engineering Assessment Activities

Law Engineering installed and sampled 17 additional ground water monitoring wells in October 1990 in an attempt to define the extent of free product accumulation and complete the assessment of dissolved hydrocarbons contamination at the site. A Comprehensive Site Assessment report was issued to the Naval Facilities Engineering Command on April 12, 1991.

3.0 EXISTING GROUNDWATER MONITORING SYSTEM

The existing groundwater monitoring system at Tank Farm A consists of 25 groundwater monitoring wells, 13GW01 through 13GW25. The locations of these wells are shown on Drawing 3.1.1. Groundwater level measurements obtained from existing monitoring wells indicate that the water table is present at approximately fifteen feet above mean seal level (MSL) and may fluctuate as much as four feet between seasonal high and low elevations. A project area limited water table contour map was prepared by Law Engineering and is shown on Drawing 3.1.2.

As shown, groundwater in the water table aquifer generally flows across the project site in a north, northwesterly direction. Based on approximate flow direction and topographic observations, it appears that groundwater is migrating toward the Mill Creek Drainage Basin located on the north side of the runway area. Mill Creek eventually discharges into Solcum Creek, which flows northward before discharging into the Neuse River.

In order to establish the quality of groundwater in the vicinity of the spill area and detect the possible presence of petroleum fuel related constituents in the surficial aquifer, the 25 monitoring wells were sampled for laboratory analysis during the

previous investigations. Laboratory analytical results indicate that groundwater in the vicinity of the tank farm area is contaminated with several organic compounds including benzene, toluene, ethylbenzene and xylenes. The estimated extent of the hydrocarbon plume is shown on Drawing 3.1.3. Free product thicknesses measured within monitoring wells during the previous assessment ranged from three to six feet. The estimated extent of the free product plume is shown on Drawing 3.1.4.

4.0 HYDROGEOLOGIC FIELD INVESTIGATION

The major objectives of the additional field investigation and groundwater assessment activities are (1) to complete the definition of the approximate lateral and vertical extent of free product accumulation and groundwater contamination resulting from the discharge of petroleum fuels at the tank farm; (2) to verify the approximate direction and rate of migration of groundwater contaminant constituents beneath the facility; and (3) to determine the aquifer characteristics of the local aquifer in order to prepare and implement the NCDEHNR required CAP for the site. In order to accomplish these objectives in a systematic and cost-effective manner, the investigation will be carried out in a three-phase approach.

Phase I will involve the acquisition of approximately 10 ground-water samples via Hydropunch sampling technique to complete the delineation of the dissolved-phase ground water contamination hydraulically downgradient of the existing monitoring system and vertically downgradient of the free product plume.

Phase II will involve the installation of four "shallow" (Type II) monitoring wells and two "deep" (Type III) monitoring wells. The purpose of the wells is as follows:

- o Two shallow wells to be sampled for the completion of the delineation of the free product plume extent.
- o Two shallow wells to be used as observation wells during the scheduled 8-hour aquifer pumping test.
- o Two deep wells to be sampled for the completion of the delineation of the vertical extent of the dissolved plume of petroleum contamination.

Phase III will involve the performance of an 8-hour pumping test and collection of data to determine the storativity and transmissivity of the local aquifer.

4.1 Proposed Hydropunch and Monitoring Well Locations

The locations of the ten Hydropunches and six monitoring wells are shown on Drawing 4.1.1. The locations may vary slightly depending on access and additional water quality data received from the Hydropunch investigation.

4.2 Hydropunch Sampling and Analysis

Collection of these ground-water samples will be accomplished by the Hydropunch ground-water sampling system being driven through the unsaturated zone into the water-bearing zone. The Hydropunch will then be opened to allow ground water to enter into the sample chamber. "Shallow" (water table) samples will be collected by lowering a small-diameter, Teflon bailer into the sample chamber. "Deep" samples, collected below the water table and above the upper confining layer, will be obtained directly from the sampling tool in the following manner. When the desired depth for collection of the sample is reached, the Hydropunch screen is opened by pulling back on the body of the tool, allowing ground water to enter into the sample chamber. Subsequently, the sample is transported to the surface within the body of the Hydropunch tool, where lower and upper check valves close to retain the sample.

At the surface, the Hydropunch is inverted and the sample is decanted through a top discharge valve and tubing into laboratory provided sample containers.

Each of the 10 hydropunch samples will be analyzed for purgeable aromatics according to EPA Method 602. In addition, one rinse blank will be analyzed for purgeable aromatics. Two of the 10 hydropunch samples will be analyzed for purgeable halocarbons according to EPA Method 601. One rinse blank will also be analyzed for purgeable halocarbons. Finally, each of the 10 hydropunch samples will be analyzed for total lead. Sample identification and chain-of-custody procedures specified in Section 4.5 of Law Engineering's Comprehensive Site Assessment Workplan (October 1990) will be followed.

4.3 Well Design, Construction, and Sampling

Specific details regarding well design, construction, development, and sampling techniques can be found in Sections 4.2 and 4.4 of the Comprehensive Site Assessment Workplan (October 1990) prepared by Law Engineering. The assessment activities discussed in this Workplan will follow the specifications and procedures set forth therein, unless otherwise specified.

4.4 Monitoring Well Development, Sampling, and Analysis

Subsequent to their completion, the six ground water monitoring wells will be thoroughly developed to remove formational silts and clays. The two free product delineation shallow monitoring wells and the two deep Type III wells will be sampled and analyzed for purgeable aromatics according to EPA Method 602 and total lead. One rinse blank will be analyzed for purgeable aromatics. The two observation wells will not be sampled for laboratory analysis.

4.5 Permeability Determination

Rising head permeability tests will be performed on five shallow monitoring wells. Based upon the available analytical data, monitoring wells 13GW5, 13GW7, 13GW8, 13GW18, and 13GW19 will be subjected to the test. In conjunction with the shallow ground water surface gradient at the site, the permeability data will be used to determine the approximate ground water seepage velocity across the site.

The test consists of removing the water from the well and then measuring the rate of recovery of the surrounding ground water. Utilizing the methods discussed in "Field Permeability Test Methods with Applications to Solution Mining", published by the

U.S. Bureau of Mines (PB-272452, August 1977), the hydraulic conductivity of the screened interval is then calculated.

Utilizing the static water level elevation data from the well survey, an average ground water surface gradient will then be determined. Based upon these data, and in combination with the calculated hydraulic conductivities, an average ground water seepage velocity will be calculated using the following modified form of Darcy's Law:

$$v = \frac{Ki}{n}$$

where v = seepage velocity
 K = hydraulic conductivity
 i = ground water surface gradient
 n = effective porosity

4.6 Disposal of Borehole Cuttings and Purge Water

Borehole cuttings will be containerized in DOT approved barrels and transported to a location for temporary storage approved by Cherry Point environmental personnel. Cherry Point environmental personnel will assume responsibility for storage and disposal of the containerized soils.

Purge water, including any water evacuated during well development, sampling, and permeability testing, will be containerized and discharged to a drop inlet, located in the Hanger 1700 area. This inlet drains into oil/water separator #33 (wash rack). The discharge point for the receiving water is the sewage treatment plant. Free product collected during well development will be containerized for subsequent pickup by MCAS Cherry Point.

4.7 Soil Sampling and Analysis

During the drilling of the two shallow "free product" wells and the two "deep" wells, soil samples will be retrieved via split spoon sampler. Two portions of each sample will be removed from the sampling device and placed in pre-labeled, airtight, plastic "twin" bags. After several minutes, the gas contained in the "headspace" or void area within one of the twin bags will be tested with a photoionization detector (PID).

The duplicate of the two samples from each borehole exhibiting the highest headspace reading will be submitted to the laboratory for analysis using the following listed methods:

<u>Parameter</u>	<u>Method</u>
Total Petroleum Hydrocarbons	SW846/5030 and 3550
TCLP Metals	
Lead	239.2
TCLP Extraction	1311

From the eight soil samples, two discretionary samples will be selected to determine pH and flash point.

5.0 COLLECTION AND ANALYSIS OF PUMPING TEST DATA

An 8-hour pumping test will be conducted on monitoring well 13GW13 to determine the performance characteristics of the well and the hydraulic parameters of the aquifer. Yield and drawdown will be recorded so that the specific capacity of the well can be calculated. These data give a measure of the productive capacity of the well and provide information needed for the selection of appropriately sized pumping equipment which may be necessary during the corrective action phase of the project.

The pumping test will also provide data from which to determine the transmissivity and storage coefficient of the surrounding aquifer in order to predict:

- o the effect of new withdrawals on existing wells;
- o the drawdowns in a well at future times and different discharges;
- o The radius of the cone of influence for individual or multiple extraction wells. This information will be used in conjunction with the RESSQC module of the Wellhead Protection Area (WHPA) ground water flow model to delineate time-related capture zones around pumping wells.

5.1 Pumping Test Procedures

Several days before the actual pumping test, the well will be pumped for several hours to determine the approximate well yield. This "Pre-test" data is necessary to select the proper size pump and establish the pumping rate to be used during the test. During the 8-hour pumping test, a constant pumping rate will be maintained, the drawdown in the surrounding observation wells will be accurately recorded at appropriate time intervals, and, after shutting down the pump, recovery data will be collected for comparative purposes. Discharge water from the pre-test and the 8-hour pumping test will be containerized. At present, plans are to batch discharge the wastewater directly to the Cherry Point MCAS wastewater treatment facility or haul the wastewater off-site to an approved treatment and disposal facility.

5.2 Pumping Well Sampling and Analysis

During the 8-hour pumping test, a sample will be collected from the discharge water. The sample will be analyzed for purgeable aromatics according to EPA Method 602, total lead, purgeable halocarbons according to EPA Method 601, and semi-volatile organic compounds according to EPA Method 625. This analytical data will be used to determine the ultimate disposition of the pumping test water.

5.3 Aquifer Parameter Determinations

The data collected during the pumping test will be used to calculate the storativity and transmissivity of the surrounding aquifer. These determinations will be made by using the modified nonequilibrium equations modified by Cooper and Jacob after Theis where:

$$S = \frac{0.3 T t_0}{r^2}$$

where: S = Storativity
 T = Transmissivity, in gpd/ft
 t₀ = intercept of the straight line at zero drawdown, in days
 r = distance, in ft, from the pumped well to the observation well

and:

$$T = \frac{264Q}{\Delta s}$$

where

T = Transmissivity in gpd/ft

Q = pumping rate, in gpm

Δs = slope of time-drawdown graph

6.0 ADDENDUM REPORT AND CAP PREPARATION

Subsequent to the evaluation of the assessment monitoring data, Law Engineering will prepare a written draft addendum (Volume III) to the Final Report of Comprehensive Site Assessment (Law Engineering, Inc., 1991). The document will summarize the field assessment activities, the laboratory analytical results, and the results of the pumping test. Subsequent to its completion, the draft report will be submitted to the Naval Facilities Engineering Command and Cherry Point MCAS for review. A final assessment report will be prepared incorporating the comments received from the Naval Facilities Engineering Command.

A draft Corrective Action Plan (CAP) will be prepared which will incorporate the text from Volumes I and III of the Comprehensive Site Assessment reports. The CAP will address the following items:

- o A narrative discussion of the proposed remediation technology and design;**
- o Proposed treatment or disposal of contaminated soil;**
- o Proposed treatment or disposal of contaminated ground water;**
- o Control of site access;**
- o Structural concerns related to adjacent buildings;**
- o Control of emissions of pollutants to the air;**
- o Follow-up site monitoring and evaluation of the Remedial Action System (RAS);**
- o Strategy for determining that the corrective action is complete (project remediation endpoints);**
- o Plan to restore the site after remediation is complete;**
- o Discussion of any state, local, or federal permits needed to implement the remediation;**
- o Proposed actions to notify persons directly affected by the release or the planned corrective action;**
- o Schedule of project implementation including a discussion of factors which affect the time to remediation endpoints, and;**
- o Schedule of operation and post-operational monitoring (to include data submittals).**

Subsequent to its completion, the draft CAP will be submitted to the Naval Facilities Engineering Command and Cherry Point MCAS for review. A final CAP will be prepared incorporating the comments received from the Naval Facilities Engineering Command.

7.0 PROJECT SCHEDULE

A schedule for implementation of this Workplan, along with appropriate milestones, is exhibited in Drawing 7.1.1.

8.0 REFERENCES

Driscoll, F.G., 1986. Groundwater and Wells, Johnson Division, St. Paul Minnesota, 1089 p.

Groundwater Section, North Carolina Department of Environment, Health and Natural Resources, Comprehensive Site Assessments at LUST Release Sites: Basic Tasks and Minimal Elements, received September 1990.

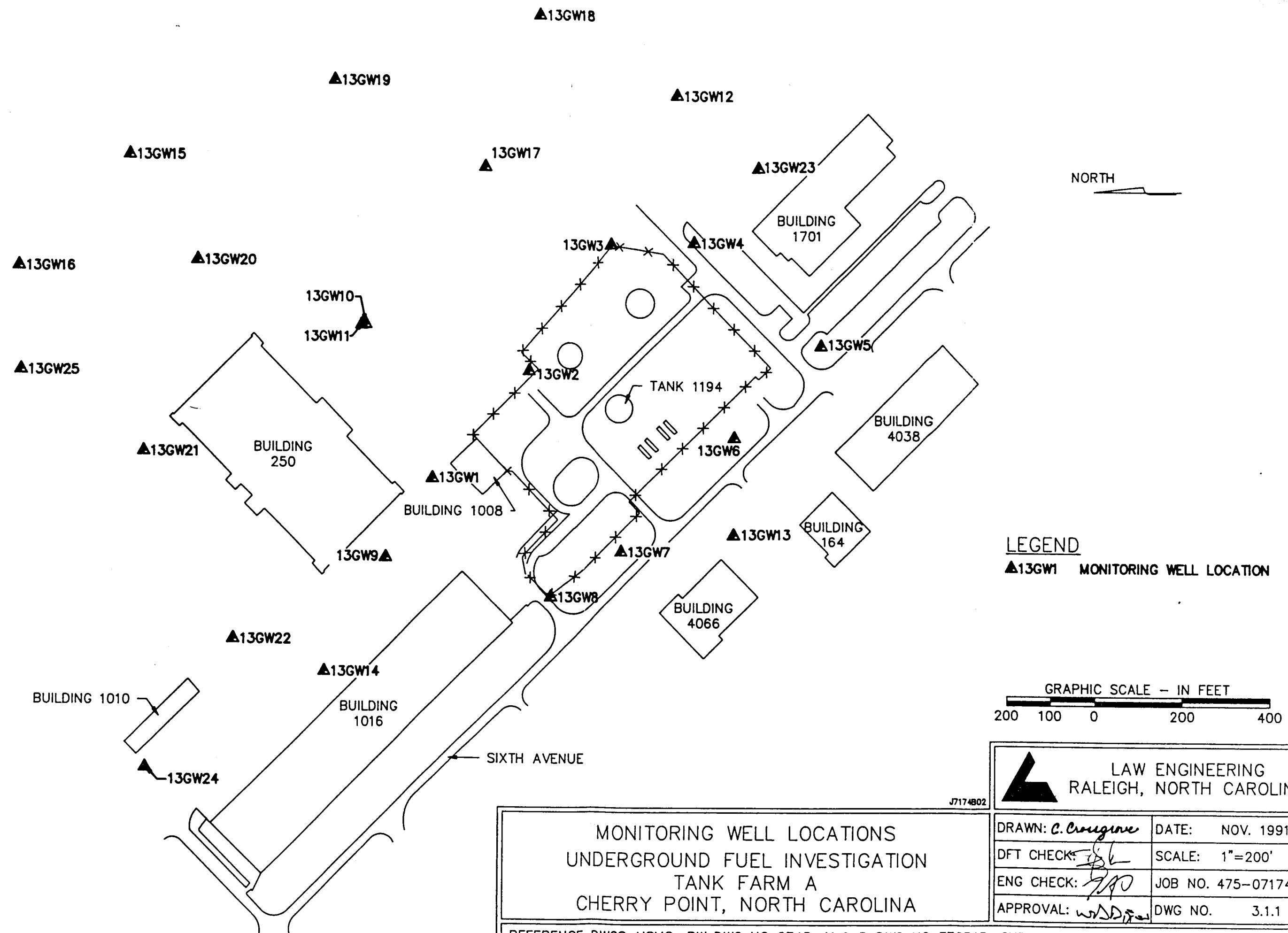
Law Engineering, Inc., Comprehensive Site Assessment Workplan, Marine Corps Air Station, Cherry Point, North Carolina, October 1990.

Law Engineering, Inc., Final Report, Underground Fuel Investigation Tank Farm A, Volume I, April 1991.

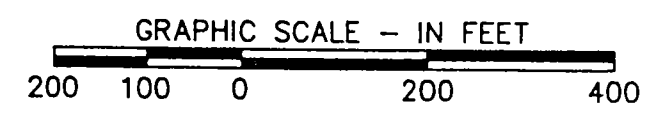
NUS Corporation, Department of the Navy, Installation Restoration Program, Remedial Investigation Interim Report, Marine Corps Air Station, Cherry Point, North Carolina, Volume I, Technical Report, October 1988.


US Bureau of Mines, Field Permeability Test Methods with Applications to Solution Mining, August, 1977.

DRAWINGS



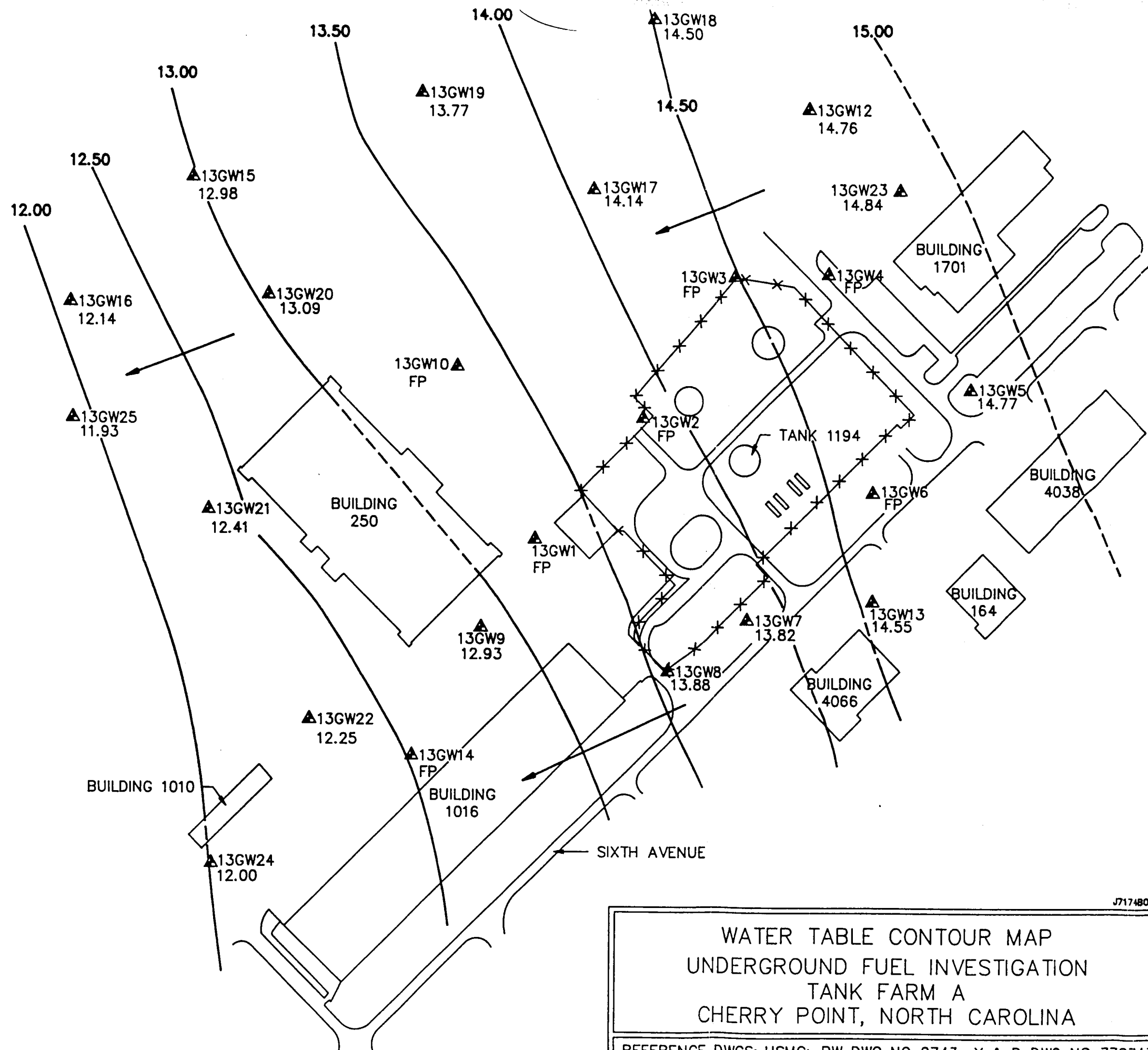
LEGEND
 ▲13GW1 MONITORING WELL LOCATION



 LAW ENGINEERING RALEIGH, NORTH CAROLINA	
DRAWN: <i>C. Cruggione</i>	DATE: NOV. 1991
DFT CHECK: <i>[Signature]</i>	SCALE: 1"=200'
ENG CHECK: <i>[Signature]</i>	JOB NO. 475-07174-04
APPROVAL: <i>[Signature]</i>	DWG NO. 3.1.1

MONITORING WELL LOCATIONS
 UNDERGROUND FUEL INVESTIGATION
 TANK FARM A
 CHERRY POINT, NORTH CAROLINA

REFERENCE DWGS: USMC; PW DWG NO 2743; Y & D DWG NO 772743; SHT 25; WATER & SANITARY SEWERAGE SYS.



NORTH

LEGEND

← APPROXIMATE DIRECTION OF GROUND-WATER FLOW IN THE WATER TABLE AQUIFER

90.00 — ESTIMATED WATER TABLE ELEVATION ISOPLETH

▲13GW1 MONITORING WELL LOCATION

91.00 MEASURED GROUND-WATER ELEVATION (11/20/90)

FP FREE PRODUCT PRESENT IN MONITORING WELL

GRAPHIC SCALE - IN FEET

200 100 0 200 400

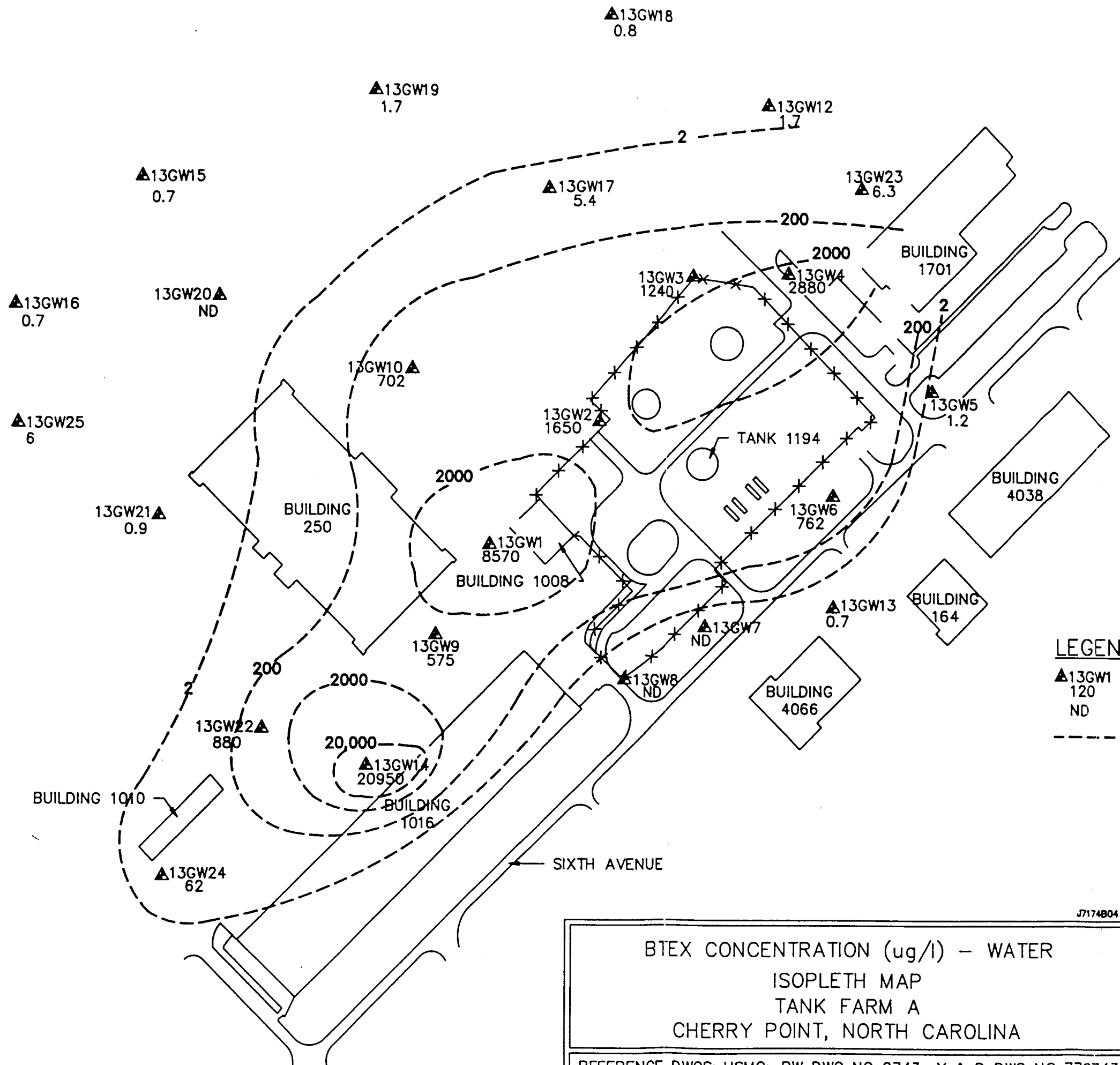
LAW ENGINEERING
RALEIGH, NORTH CAROLINA

J7174803

DRAWN: <i>SL</i>	DATE: NOV. 1991
DFT CHECK: <i>SL</i>	SCALE: 1"=200'
ENG CHECK: <i>280</i>	JOB NO. 475-07174-04
APPROVAL: <i>WAD</i>	DWG NO. 3.1.2

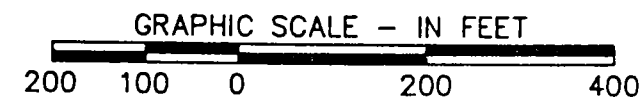
WATER TABLE CONTOUR MAP
UNDERGROUND FUEL INVESTIGATION
TANK FARM A
CHERRY POINT, NORTH CAROLINA

REFERENCE DWGS: USMC; PW DWG NO 2743; Y & D DWG NO 772743; SHT 25; WATER & SANITARY SEWERAGE SYS.



LEGEND

- ▲13GW1 120 MONITORING WELL LOCATION WITH BTEX VALUE
- ND NOT DETECTED
- CONTAMINANT ISOPLETH



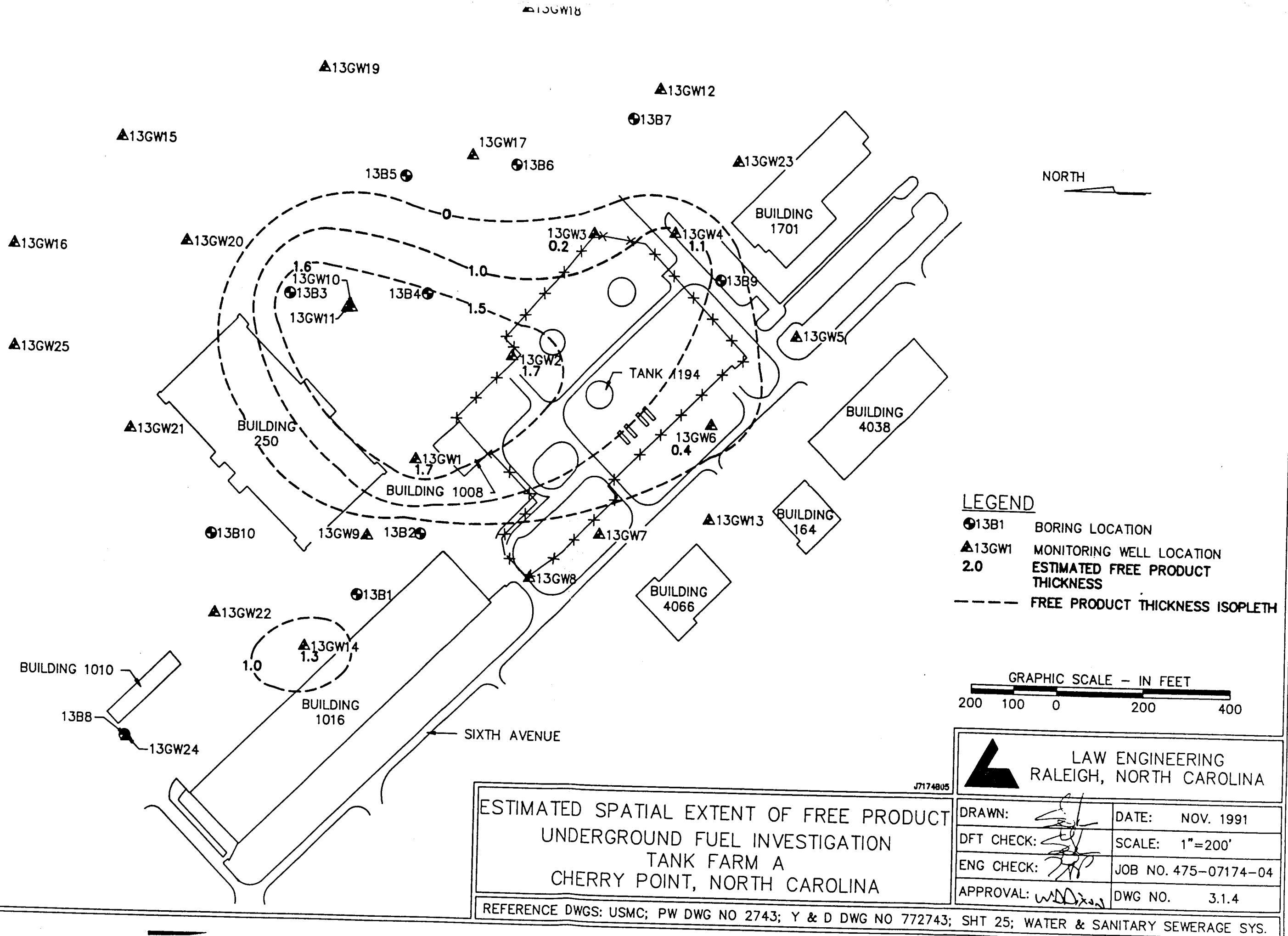
LAW ENGINEERING
RALEIGH, NORTH CAROLINA

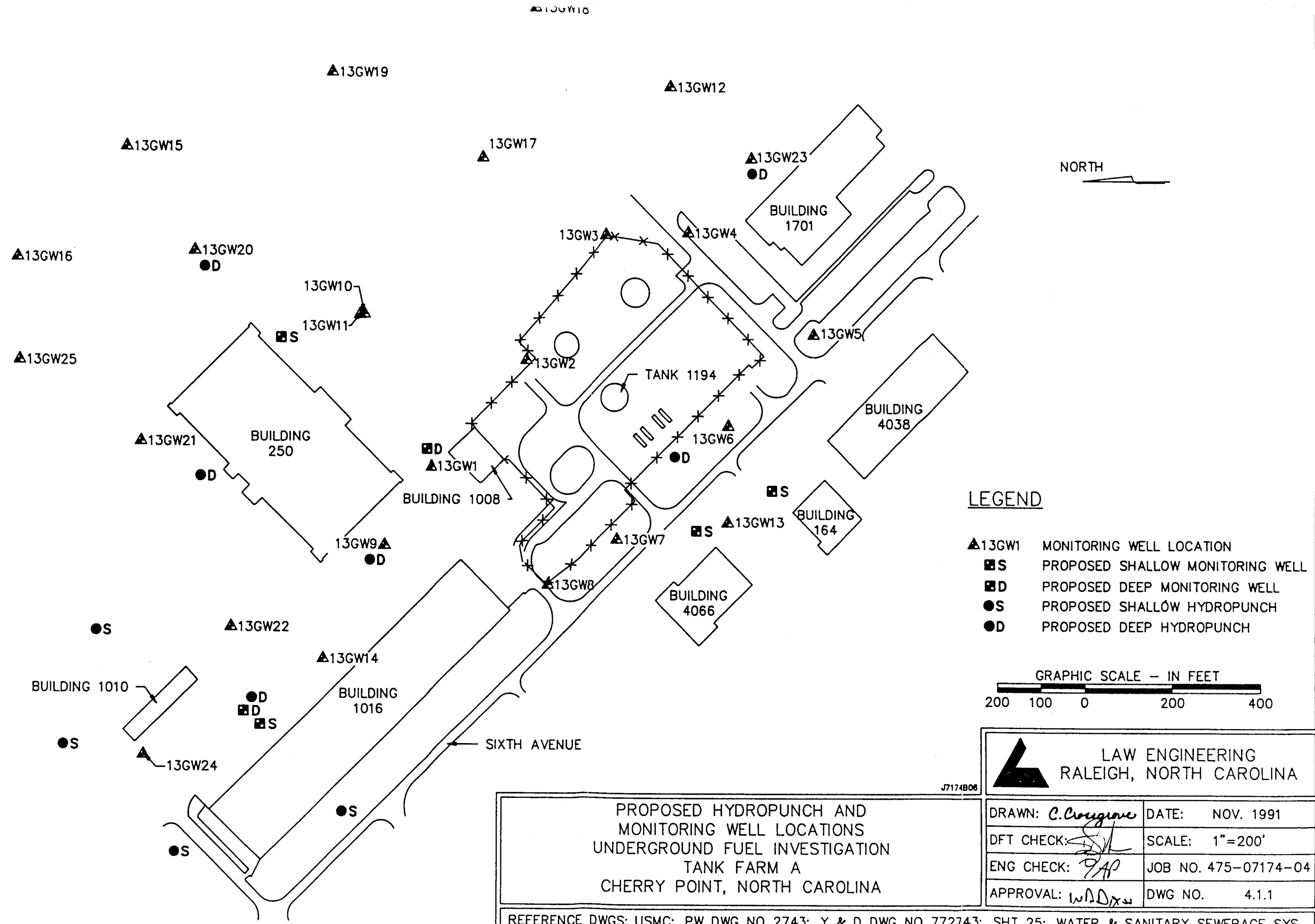
J7174804

BTEX CONCENTRATION (ug/l) - WATER
ISOPLETH MAP
TANK FARM A
CHERRY POINT, NORTH CAROLINA

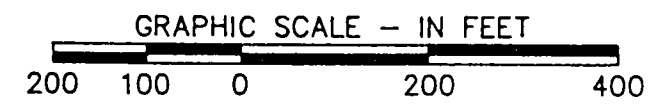
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ENG CHECK: <i>[Signature]</i>	JOB NO. 475-07174-04
APPROVAL: <i>[Signature]</i>	DWG NO. 3.1.3


REFERENCE DWGS: USMC; PW DWG NO 2743; Y & D DWG NO 772743; SHT 25; WATER & SANITARY SEWERAGE SYS.





- LEGEND**
- ▲13GW1 MONITORING WELL LOCATION
 - S PROPOSED SHALLOW MONITORING WELL
 - D PROPOSED DEEP MONITORING WELL
 - S PROPOSED SHALLOW HYDROPUNCH
 - D PROPOSED DEEP HYDROPUNCH



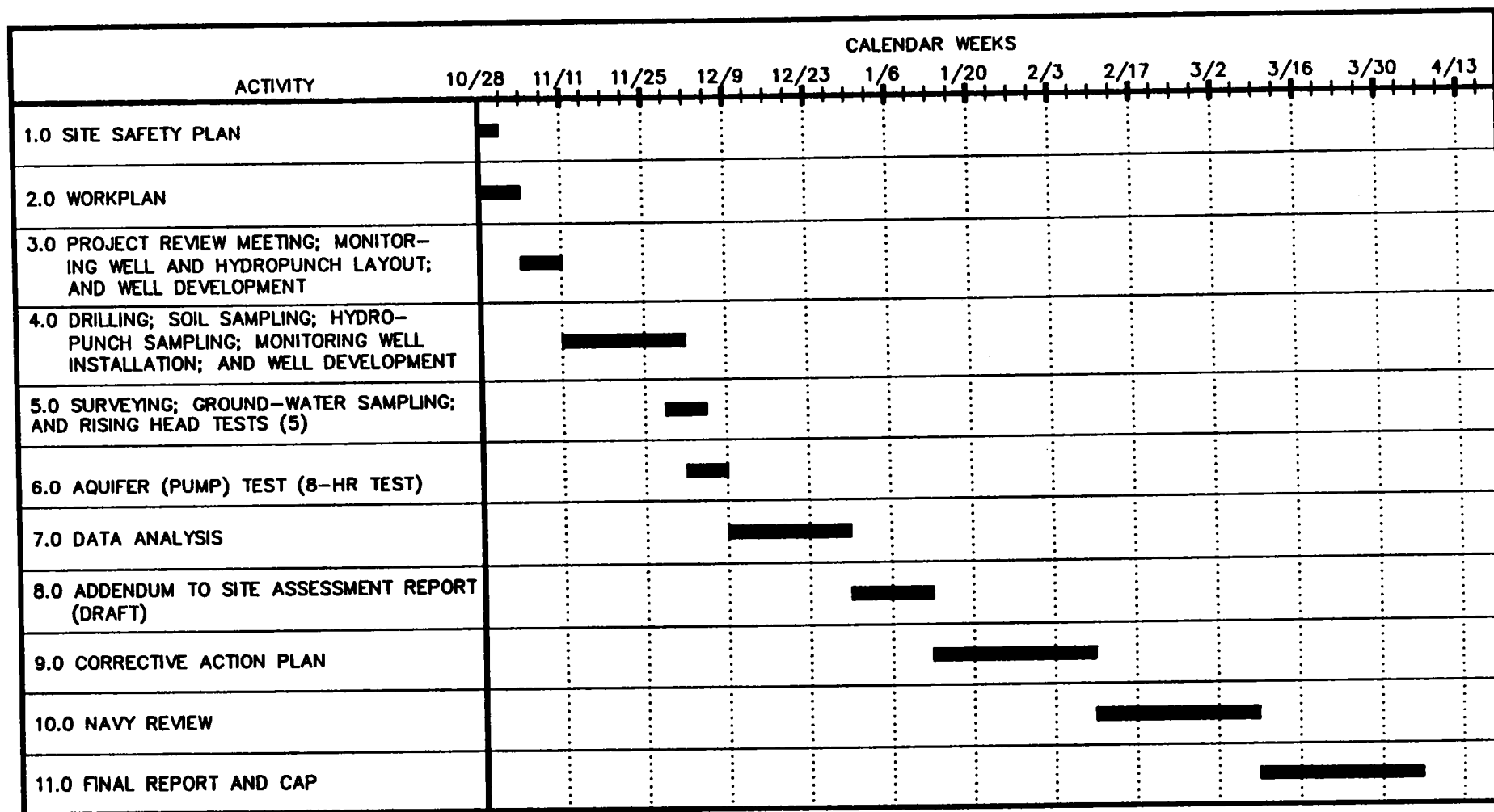
 LAW ENGINEERING RALEIGH, NORTH CAROLINA	
DRAWN: <i>C. Crisgione</i>	DATE: NOV. 1991
DFT CHECK: <i>SL</i>	SCALE: 1"=200'
ENG CHECK: <i>GAP</i>	JOB NO. 475-07174-04
APPROVAL: <i>W.D. Xu</i>	DWG NO. 4.1.1

PROPOSED HYDROPUNCH AND
 MONITORING WELL LOCATIONS
 UNDERGROUND FUEL INVESTIGATION
 TANK FARM A
 CHERRY POINT, NORTH CAROLINA

REFERENCE DWGS: USMC; PW DWG NO 2743; Y & D DWG NO 772743; SHT 25; WATER & SANITARY SEWERAGE SYS.

DRAWING NO. 7.1.1 - PROJECT SCHEDULE

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
UNDERGROUND FUEL INVESTIGATIONS
TANK FARM A
CHERRY POINT, NORTH CAROLINA



APPENDIX A
HEALTH AND SAFETY PLAN

**HEALTH AND SAFETY PLAN
TANK FARM A INVESTIGATION
CHERRY POINT, NORTH CAROLINA**

PROJECT NAME: Tank Farm A Assessment
LOCATION OF SITE: Cherry Point MCAS
LAW JOB NO. 47591-07174-04
CLIENT: United States Navy Department-Atlantic Division

REVIEW AND APPROVAL

Principal Environmental Engineer	W. Douglass Dixon, P.E. _____
Project Manager	W. Douglass Dixon, P.E. _____
Site Manager	Tom Proctor, P.G. _____

DATE OF PLAN PREPARATION

October 29, 1991

DATES OF PLAN PLANNED FIELD ACTIVITIES

November 11, 1991 - December 6, 1991

SAFETY MEETING CONDUCTED: (LOCATION) _____ (DATE): _____

EMERGENCY PHONE NUMBERS

Base Naval Hospital: Building 296
Hospital route is shown on attached Drawing 1.

Base Naval Hospital: 466-5751 or 111 or 911
Base Fire Department: 466-3333
Military Police: 466-3615 or 110

Senior Project Professional:	W. Douglass Dixon	(919) 876-0416
Health and Safety Officer:	Stanley J. Harward	(919) 876-0416
Military Contact:	Mahlon Yokley	(919) 466-4598

DESCRIPTION OF POTENTIAL HAZARDS

- Exposure to petroleum fuels through inhalation, skin absorption or ingestion
- Fire or Explosion
- Vehicular Traffic

PERSONNEL ACCESS

Personnel who attended LAW's site safety meeting and are authorized to enter this site:

- 1) _____
- 2) _____
- 3) _____
- 4) _____
- 5) _____
- 6) _____
- 7) _____
- 8) _____
- 9) _____
- 10) _____

By signing this form, the listed individual acknowledges that he has read, and understands, and will comply with the requirements of this Health and Safety Plan.

PLANNED FIELD ACTIVITIES

- Perform 10 hydropunch samples to an approximate depth of 20 to 47 feet.
- Install 4 ground-water monitoring wells to an approximate depth of 25 feet.
- Install 2 double cased monitoring wells to an approximate depth of 47 feet.
- Decontamination of drilling equipment.
- Develop and sample monitoring wells.
- Dispose of drill cuttings and purged water.
- Conduct an 8 hour pumping test.

MONITORING PROCEDURES

Ambient air monitoring for the presence of volatile organic compounds with a photoionization detector (PID) will be periodically performed in the drilling area. Testing will be conducted for approximately three minutes at a minimum of one test

per hour or at other times when site conditions (e.g. evidence of free product, increase in detectable odors, site workers sensitivity) exhibit the need for additional testing. The Site Manager will record the time, location and result of each test. IN the event that PID readings exceed a level of 50 ppm for more than on-half of any three minute testing interval, the work site will be evacuated pending additional testing or proper ventilation. The action level of 50 ppm represents the permissible exposure limit (PEL) for naphtha and coal tars as established by the Occupational Safety and Health Administration (OSHA). If further testing reveals that ambient air contains volatile organic compounds in excess of 50 ppm, respirators designed for removal of toxic organics will be required for all site workers. Should concentrations exceed 2500 ppm, all site work will cease and the site will be evacuated pending guidance from the Corporate Health and Safety Officer.

Continuous ambient air monitoring for the presence of explosive gases with an explosimeter will be performed in the drilling area at suspect locations. All personnel access/work in the drilling area must STOP if air readings exceed 20% of Lower-Explosive Limit (LEL) until readings consistently exhibit concentrations of gases of less than 20% LEL.

DECONTAMINATION (Petroleum products)

Skin	-	wash with soap and water
Eyes	-	flush with copious amounts of water
Clothing	-	wash with detergent and rinse thoroughly
Equipment	-	steam clean or detergent wash

MEDICAL SURVEILLANCE

All Law Engineering field personnel participate in the corporate annual environmental medical surveillance program.

Avoid frequent or prolonged skin contact. Monitor skin and eyes for dermatitis, allergic reaction, and eye irritation. If these or other symptoms develop, seek qualified medical attention.

Symptoms of Acute Exposure to Volatile Organics: High vapor levels can cause irritation of the respiratory tract, headaches, nausea and mental confusion. Loss of consciousness occurs with very high concentrations. Liquid contact with skin may cause defatting, drying and irritation. Both vapor and liquid phases are irritating to the eyes.

EMERGENCY PROCEDURES (Petroleum products)

- | | | |
|------------|---|---|
| Skin | - | wash with soap and water, rinse well |
| Inhalation | - | move to fresh air at least 50 feet upwind from vapor source.
Seek qualified medical attention. |
| Ingestion | - | do not induce vomiting. If conscious, give water or milk to drink.
Seek qualified medical attention. |
| Eyes | - | flush for a minimum of ten minutes with clean water while
holding eyes open. Seek qualified medical attention. |

HEAT STRESS

Symptoms of heat stress include pale, cool or moist skin, excessive sweating, dizziness, nausea, and muscle spasms. Symptoms of heat stroke include red, hot and unusually dry skin, reduced perspiration, nausea, dizziness or confusion, rapid pulse rate and coma.

To prevent heat stress, adjust work schedule, provide shaded rest areas, and maintain body fluids.

CLOTHING AND PROTECTIVE GEAR

REQUIRED at work site further drilling activities: Nitrile rubber gloves, steel-toed boots, protective eyewear, hard hats.

****The Project Manager or the Senior Professional should be contacted prior to changes in personnel protective equipment usage.**

To be READILY AVAILABLE on site:

- Full face respirator with volatile organic cartridges.
- Nitrile rubber boots.
- Tyvek suits.
- Cotton glove liners, if needed.

IN THE EVENT OF PERSONNEL INJURY

Provide basic first aid procedures as required and note time and circumstances of injuries. Call for an ambulance or transport to nearest medical facility (Drawing 1) as appropriate. Notify Project Manager and Military Contact.

Only emergency medical care is available in Government facilities to Contractor employees who suffer on-the-job injury or disease. Care will be rendered under the conditions and at the rates in effect at the time of treatment. The contractor shall reimburse the Naval Regional Medical Center Collection Agent promptly upon receipt of statement.

Non-emergency medical services may be obtained at the nearest civilian hospital which is: Onslow Memorial Hospital, 3317 Western Boulevard, Jacksonville, North Carolina (919-577-2345.)

IN THE EVENT OF POTENTIAL OR ACTUAL FIRE OR EXPLOSION

Evacuate the area immediately. Assemble in the predesigned area and conduct a head count of all personnel. Notify base fire department. **DO NOT** attempt to fight the fire. Notify Project Manager, Military Contact and the Base Fire Department.

ACCIDENT REPORTING

Personnel injuries and vehicle accidents should be reported to the Branch Safety Officer within 24 hours of incident.

WORK PRECAUTIONS

- 1) No smoking, eating, drinking or chewing of gum or tobacco products while on the site. Avoid hand to mouth contact. A designated smoking and break area may be established off site. Any such facility must be a minimum of 100 feet from any vapor source and shall be tested for flammable gases and vapors at the start of work and prior to scheduled break periods each day.
- 2) Hard hats are required to be worn at all times at drilling locations. Face shields or goggles will be worn whenever the potential for chemical splash or flying debris is present. Use of Nitrile gloves and safety glasses are required.
- 3) Barricade work area if located in a high vehicular traffic areas.
- 4) Decontamination of equipment, clothing and personnel shall be in accordance with the previous section entitled "Decontamination".
- 5) Removal and transfer of flammable liquids from a container to receiving vessel requires proper grounding of the container to the receiving vessel in order to prevent build-up and discharge of static electricity.

- 6) Personnel must wash all exposed skin areas with soap and water before departing the site or going on break.
- 7) Prior to the start of work, LAW personnel shall be briefed on the contents of this plan by the Project Manager.

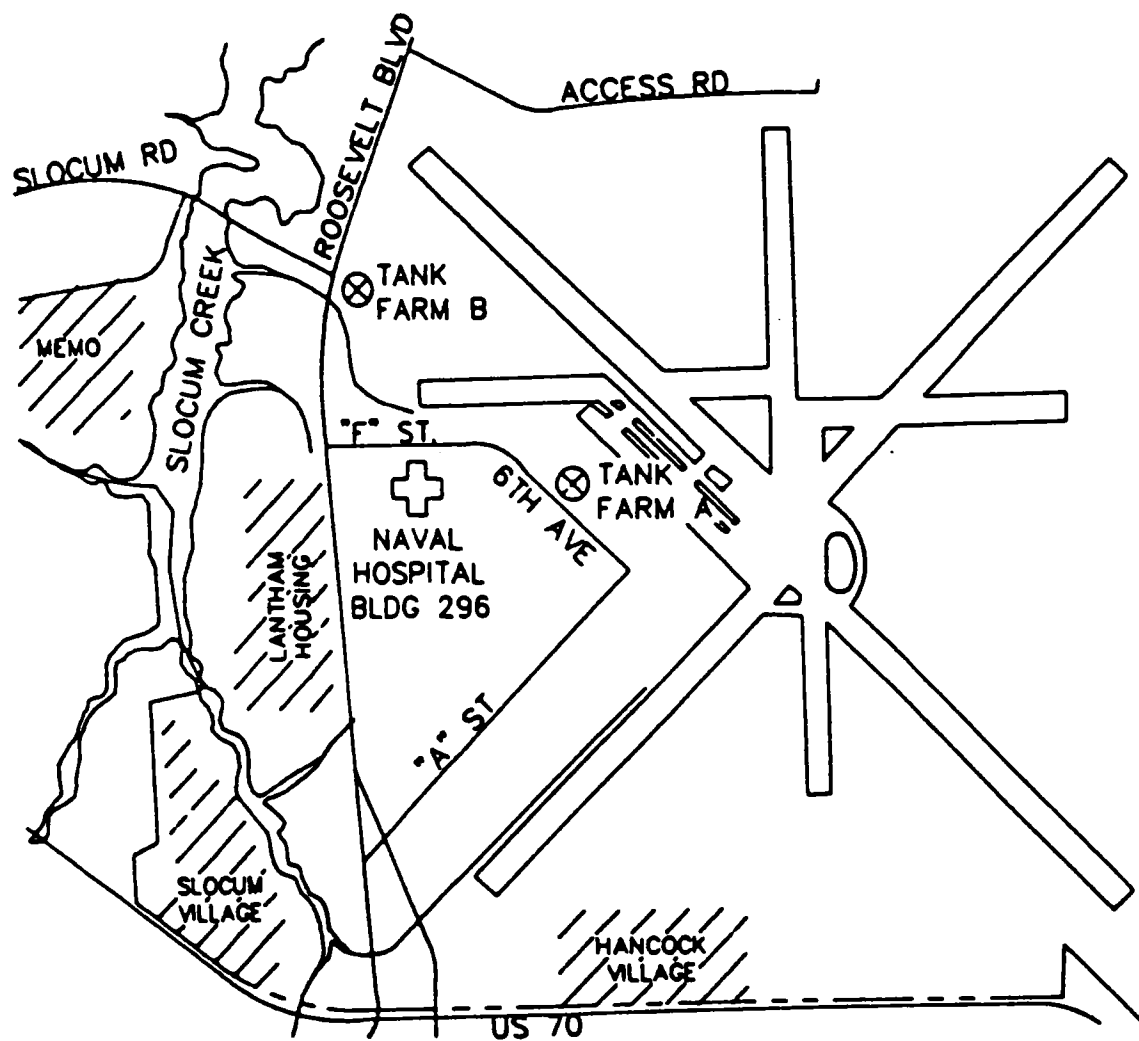
SITE MANAGER SUMMARY

During the work covered by this Safety Plan, there were:

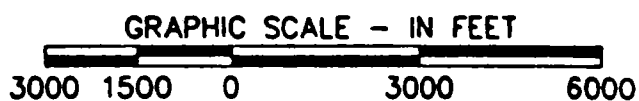
___ No observed violations of the Safety Plan provisions.

___ The following violations of the Safety Plan provisions (give details in space below and indicate corrective action taken for each violation noted).

Signature _____ Date _____
SITE MANAGER



NORTH



J5013802



LAW ENGINEERING
RALEIGH, NORTH CAROLINA

HOSPITAL ROUTE
MCAS CHERRY POINT
UST/GROUND WATER SURVEY
CHERRY POINT, NORTH CAROLINA

DRAWN: <i>[Signature]</i>	DATE: SEPT. 1990
DFT CHECK: <i>[Signature]</i>	SCALE: 1"=3000'
ENG CHECK: <i>[Signature]</i>	JOB NO. J47590-6013
APPROVAL:	DWG NO. 1

APPENDIX B

HYDROPUNCH LABORATORY ANALYTICAL TEST REPORTS

Law Environmental, Inc.
Pensacola Branch
7215 Pine Forest Road
Pensacola, Florida 32526



December 12, 1991

Mr. Chris Cornelissen
Law Engineering, Inc.
3301 Atlantic Avenue
Raleigh, NC 27604
Clt. #12024 Proj. #475-07174-04

Dear Mr. Cornelissen:

Below are results of analysis of 6 samples received for examination on November 23, 1991:

Location code: CP2 Loc. Desc.: ~~HP-48~~
LAB I.D. AA15570 P.O./Project No.: 0717404 Client No.: 12024
Collection Date: 11/21/91 Collection Time: 10:08
Submittal Date: 11/23/91 Submittal Time: 12:09
Sample collector: CORNELISSEN

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
-------------------	-------	----------------	--------------------

Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	2	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	4	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	9	1.0

2310-Furnace Dig W. EPA 3020

done

Multicomponent analysis: 2310-Fur. Metals W. EPA 7000

Lead	ug/L	180	2.0
------	------	-----	-----

Location code: CP2 Loc. Desc.: ~~HP-48~~
LAB I.D. AA15571 P.O./Project No.: 0717404 Client No.: 12024
Collection Date: 11/21/91 Collection Time: 09:22
Submittal Date: 11/23/91 Submittal Time: 12:09
Sample collector: CORNELISSEN

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
-------------------	-------	----------------	--------------------

Mr. Chris Cornelissen
Page: 2
December 12, 1991

Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	Not Det	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	Not Det	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	Not Det	1.0

2310-Furnace Dig W. EPA 3020

Multicomponent analysis: 2310-Fur. Metals W. EPA 7000

Lead	ug/L	120	2.0
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Location code: CP2 Loc. Desc.: ~~HP-9D~~
LAB I.D. AA15572 P.O./Project No.: 0717404 Client No.: 12024
Collection Date: 11/21/91 Collection Time: 08:16
Submittal Date: 11/23/91 Submittal Time: 12:09
Sample collector: CORNELISSEN

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
-------------------	-------	----------------	--------------------

Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	10	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	Not Det	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	Not Det	1.0

2310-Furnace Dig W. EPA 3020

Multicomponent analysis: 2310-Fur. Metals W. EPA 7000

Lead	ug/L	180	2.0
------	------	-----	-----

Mr. Chris Cornelissen
Page: 3
December 12, 1991

Location code: CP2 Loc. Desc.: ~~TRIP BLANK~~
LAB I.D. AA15573 P.O./Project No.: 0717404 Client No.: 12024
Collection Date: 11/21/91
Submittal Date: 11/23/91 Submittal Time: 12:09
Sample collector: CORNELISSEN

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
-------------------	-------	----------------	--------------------

Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	Not Det	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	Not Det	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	Not Det	1.0

Location code: CP2 Loc. Desc.: 13GW27 S2
LAB I.D. AA15574 P.O./Project No.: 0717404 Client No.: 12024
Collection Date: 11/22/91 Collection Time: 13:20
Submittal Date: 11/23/91 Submittal Time: 12:09
Sample collector: CORNELISSEN

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Multicomponent analysis: 2321-TPHVS Cal-DHS
Gasoline mg/Kg

Not Det 0.2

Multicomponent analysis: 2321-TPHXS Cal-DHS
Diesel mg/Kg
2323-Tot. Pet. Hydro. Prep. Soil

Not Det 4.0
done

Multicomponent analysis: 2310-Fur. Metals S. EPA 7000
Lead mg/kg
2310-Furnace Dig S. EPA 3050

5 0.4
done

[illegible]

Law Environmental, Inc.
Pensacola Branch
7215 Pine Forest Road
Pensacola, Florida 32526



December 18, 1991

Mr. Chris Cornelissen
Law Engineering, Inc.
3301 Atlantic Avenue
Raleigh, NC 27604
Clt.#12024 Proj.#475-07174-04

Dear Mr. Cornelissen:

Below are results of analysis of 8 samples received for examination on November 27, 1991:

Location code: CP3 Loc. Desc.: ~~HP-28~~
LAB I.D. AA15714 P.O./Project No.: 47507174 Client No.: 12024
Collection Date: 11/26/91 Collection Time: 17:05
Submittal Date: 11/27/91 Submittal Time: 15:55
Sample collector: CORNELISSEN

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	.9	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	Not Det	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	Not Det	1.0

2310-Furnace Dig W. EPA 3020

done

Multicomponent analysis: 2310-Fur. Metals W. EPA 7000

Lead	ug/L	140	2.0
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Location code: CP3 Loc. Desc.: ~~HP-28~~ HP-5D
LAB I.D. AA15715 P.O./Project No.: 47507174 Client No.: 12024
Collection Date: 11/26/91 Collection Time: 15:30
Submittal Date: 11/27/91 Submittal Time: 15:55
Sample collector: CORNELISSEN

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Mr. Chris Cornelissen

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December 18, 1991

Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	Not Det	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	Not Det	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	Not Det	1.0

2310-Furnace Dig W. EPA 3020

done

Multicomponent analysis: 2310-Fur. Metals W. EPA 7000

Lead	ug/L	58	2.0
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Location code: CP3 Loc. Desc.: HP-6D
LAB I.D. AA15716 P.O./Project No.: 47507174 Client No.: 12024
Collection Date: 11/25/91 Collection Time: 15:45
Submittal Date: 11/27/91 Submittal Time: 15:55
Sample collector: CORNELISSEN

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	Not Det	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	Not Det	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	Not Det	1.0

Multicomponent analysis: 2321-VOA W. by GC EPA 601

Bromodichloromethane	ug/L	Not Det	0.3
Bromoform	ug/L	Not Det	0.6
Bromomethane	ug/L	Not Det	5.0
Carbon tetrachloride	ug/L	Not Det	1.0
Chloroethane	ug/L	Not Det	5.0
2-Chloroethylvinyl ether	ug/L	Not Det	1.0
Chloroform	ug/L	Not Det	2.0
Chloromethane	ug/L	Not Det	5.0
Dibromochloromethane	ug/L	Not Det	0.9
1,2-Dichlorobenzene	ug/L	Not Det	0.3

Mr. Chris Cornelissen
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2321-VOA W. by GC EPA 601 (continued):

1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
1,1-Dichloroethane	ug/L	Not Det	0.6
1,2-Dichloroethane	ug/L	Not Det	1.0
1,1-Dichloroethene	ug/L	Not Det	0.9
trans-1,2-Dichloroethene	ug/L	Not Det	0.6
1,2-Dichloropropane	ug/L	Not Det	0.3
cis-1,3-Dichloropropene	ug/L	Not Det	0.6
trans-1,3-Dichloropropene	ug/L	Not Det	0.6
Methylene chloride	ug/L	Not Det	5.0
1,1,2,2,-Tetrachloroethane	ug/L	Not Det	2.0
Tetrachloroethene	ug/L	Not Det	1.0
1,1,1-Trichloroethane	ug/L	Not Det	1.0
1,1,2-Trichloroethane	ug/L	Not Det	0.9
Trichloroethene	ug/L	Not Det	0.6
Trichlorofluoromethane	ug/L	Not Det	0.9
Vinyl chloride	ug/L	Not Det	5.0

2310-Furnace Dig W. EPA 3020

Multicomponent analysis: 2310-Fur. Metals W. EPA 7000
 Lead ug/L 22 2.0

Location code: CP3 Loc. Desc.: HP-7D
 LAB I.D. AA15717 P.O./Project No.: 47507174 Client No.: 12024
 Collection Date: 11/25/91 Collection Time: 14:10
 Submittal Date: 11/27/91 Submittal Time: 15:55
 Sample collector: CORNELISSEN

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	2	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	1	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	3	1.0

2310-Furnace Dig W. EPA 3020

Multicomponent analysis: 2310-Fur. Metals W. EPA 7000
 Lead ug/L 5 2.0

Mr. Chris Cornelissen
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 December 18, 1991

Location code: CP3 Loc. Desc. ~~HP-8D~~
 LAB I.D. AA15718 P.O./Project No.: 47507174 Client No.: 12024
 Collection Date: 11/25/91 Collection Time: 12:05
 Submittal Date: 11/27/91 Submittal Time: 15:55
 Sample collector: CORNELISSEN

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	24	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	Not Det	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	1	1.0

Multicomponent analysis: 2321-VOA W. by GC EPA 601

Bromodichloromethane	ug/L	Not Det	0.3
Bromoform	ug/L	Not Det	0.6
Bromomethane	ug/L	Not Det	5.0
Carbon tetrachloride	ug/L	Not Det	1.0
Chloroethane	ug/L	Not Det	5.0
2-Chloroethylvinyl ether	ug/L	Not Det	1.0
Chloroform	ug/L	Not Det	2.0
Chloromethane	ug/L	Not Det	5.0
Dibromochloromethane	ug/L	Not Det	0.9
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
1,1-Dichloroethane	ug/L	Not Det	0.6
1,2-Dichloroethane	ug/L	Not Det	1.0
1,1-Dichloroethene	ug/L	Not Det	0.9
trans-1,2-Dichloroethene	ug/L	Not Det	0.6
1,2-Dichloropropane	ug/L	Not Det	0.3
cis-1,3-Dichloropropene	ug/L	Not Det	0.6
trans-1,3-Dichloropropene	ug/L	Not Det	0.6
Methylene chloride	ug/L	Not Det	5.0
1,1,2,2,-Tetrachloroethane	ug/L	Not Det	2.0
Tetrachloroethene	ug/L	Not Det	1.0
1,1,1-Trichloroethane	ug/L	Not Det	1.0
1,1,2-Trichloroethane	ug/L	Not Det	0.9
Trichloroethene	ug/L	Not Det	0.6
Trichlorofluoromethane	ug/L	Not Det	0.9
Vinyl chloride	ug/L	Not Det	5.0

2310-Furnace Dig W. EPA 3020

done

Mr. Chris Cornelissen
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Sample AA15718 (continued)

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
Multicomponent analysis: 2310-Fur. Metals W. EPA 7000			
Lead	ug/L	250	2.0

Location code: CP3 Loc. Desc.: ~~HP-10D~~
LAB I.D. AA15719 P.O./Project No.: 47507174 Client No.: 12024
Collection Date: 11/26/91 Collection Time: 14:08
Submittal Date: 11/27/91 Submittal Time: 15:55
Sample collector: CORNELISSEN

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	820	5.0
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	6	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	1	1.0
2310-Furnace Dig W. EPA 3020		done	

Multicomponent analysis: 2310-Fur. Metals W. EPA 7000
Lead ug/L 20 2.0

Location code: CP3 Loc. Desc.: ~~Rinse Blank~~
LAB I.D. AA15720 P.O./Project No.: 47507174 Client No.: 12024
Collection Date: 11/25/91
Submittal Date: 11/27/91 Submittal Time: 15:55
Sample collector: CORNELISSEN

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Multicomponent analysis: 2321-VOA W. by GC EPA 602

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2321-VOA W. by GC EPA 602 (continued):

Benzene	ug/L	Not Det	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	Not Det	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	Not Det	1.0

Multicomponent analysis: 2321-VOA W. by GC EPA 601

Bromodichloromethane	ug/L	Not Det	0.3
Bromoform	ug/L	Not Det	0.6
Bromomethane	ug/L	Not Det	5.0
Carbon tetrachloride	ug/L	Not Det	1.0
Chloroethane	ug/L	Not Det	5.0
2-Chloroethylvinyl ether	ug/L	Not Det	1.0
Chloroform	ug/L	2	2.0
Chloromethane	ug/L	Not Det	5.0
Dibromochloromethane	ug/L	Not Det	0.9
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
1,1-Dichloroethane	ug/L	Not Det	0.6
1,2-Dichloroethane	ug/L	Not Det	1.0
1,1-Dichloroethene	ug/L	Not Det	0.9
trans-1,2-Dichloroethene	ug/L	Not Det	0.6
1,2-Dichloropropane	ug/L	Not Det	0.3
cis-1,3-Dichloropropene	ug/L	Not Det	0.6
trans-1,3-Dichloropropene	ug/L	Not Det	0.6
Methylene chloride	ug/L	Not Det	5.0
1,1,2,2,-Tetrachloroethane	ug/L	Not Det	2.0
Tetrachloroethene	ug/L	Not Det	1.0
1,1,1-Trichloroethane	ug/L	Not Det	1.0
1,1,2-Trichloroethane	ug/L	Not Det	0.9
Trichloroethene	ug/L	Not Det	0.6
Trichlorofluoromethane	ug/L	Not Det	0.9
Vinyl chloride	ug/L	Not Det	5.0

Location code: CP3 Loc. Desc.: Trip Blank
LAB I.D. AA15721 P.O./Project No.: 47507174 Client No.: 12024
Collection Date: 11/25/91
Submittal Date: 11/27/91 Submittal Time: 15:55
Sample collector: CORNELISSEN

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Mr. Chris Cornelissen
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Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	Not Det	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	Not Det	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	1	1.0

Please advise should you have questions concerning these data.

Respectfully submitted,

D. Albright for
James M.G. Tucci, Laboratory Manager

[illegible]

Law Environmental, Inc.
Pensacola Branch
7215 Pine Forest Road
Pensacola, Florida 32526



January 8, 1992

Mr. Chris Cornelissen
Law Engineering, Inc.
3301 Atlantic Avenue
Raleigh, NC 27604
Clt. #12024 Proj. #475-07174-04

Dear Mr. Cornelissen:

Below are results of analysis of 1 sample received for examination
on December 14, 1991:

Location code: CP11 Loc. Desc.: HP-118
LAB I.D. AA16114 P.O./Project No.: 0717404 Client No.: 12024
Collection Date: 12/11/91
Submittal Date: 12/14/91 Submittal Time: 12:00
Sample collector: LISTED ON COC

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Multicomponent analysis: 2321-VOA W. by GC EPA 601

Bromodichloromethane	ug/L	Not Det	0.3
Bromoform	ug/L	Not Det	0.6
Bromomethane	ug/L	Not Det	5.0
Carbon tetrachloride	ug/L	Not Det	1.0
Chloroethane	ug/L	Not Det	5.0
2-Chloroethylvinyl ether	ug/L	Not Det	1.0
Chloroform	ug/L	Not Det	2.0
Chloromethane	ug/L	Not Det	5.0
Dibromochloromethane	ug/L	Not Det	0.9
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
1,1-Dichloroethane	ug/L	Not Det	0.6
1,2-Dichloroethane	ug/L	Not Det	1.0
1,1-Dichloroethene	ug/L	Not Det	0.9
trans-1,2-Dichloroethene	ug/L	Not Det	0.6
1,2-Dichloropropane	ug/L	Not Det	0.3
cis-1,3-Dichloropropene	ug/L	Not Det	0.6
trans-1,3-Dichloropropene	ug/L	Not Det	0.6
Methylene chloride	ug/L	Not Det	5.0
1,1,2,2,-Tetrachloroethane	ug/L	Not Det	2.0
Tetrachloroethene	ug/L	Not Det	1.0
1,1,1-Trichloroethane	ug/L	Not Det	1.0

Mr. Chris Cornelissen
Page: 2
January 8, 1992

2321-VOA W. by GC EPA 601 (continued):

1,1,2-Trichloroethane	ug/L	Not Det	0.9
Trichloroethene	ug/L	Not Det	0.6
Trichlorofluoromethane	ug/L	Not Det	0.9
Vinyl chloride	ug/L	Not Det	5.0

Multicomponent analysis: 2321-VOA W. by GC EPA 602

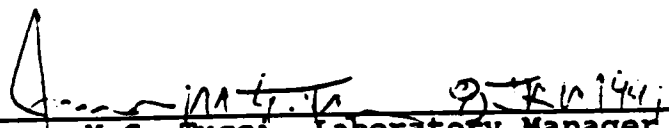
Benzene	ug/L	Not Det	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	.8	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	Not Det	1.0

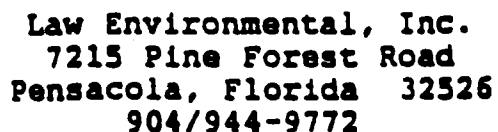
Multicomponent analysis: 2310-Fur. Metals W. EPA 7000

Lead	ug/L	22	2.0
2310-Furnace Dig W. EPA 3020		done	

Please advise should you have questions concerning these data.

Respectfully submitted,


James M.G. Tucci, Laboratory Manager



Comments:

Law Environmental, Inc.
Pensacola Branch
7215 Pine Forest Road
Pensacola, Florida 32526



January 20, 1992

Mr. Chris Cornelissen
Law Engineering, Inc.
3301 Atlantic Avenue
Raleigh, NC 27604
Clt. #12024 Proj. #07174-04

Dear Mr. Cornelissen:

Below are results of analysis of 1 sample received for examination
on December 23, 1991:

Location code: CP14 Loc. Desc.: HP-14S
LAB I.D. AA16520 P.O./Project No.: 0717404 Client No.: 12024
Collection Date: 12/20/91 Submittal Time: 13:42
Submittal Date: 12/23/91
Sample collector: PROCTOR

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Multicomponent analysis: 2321-VOA W. by GC EPA 602

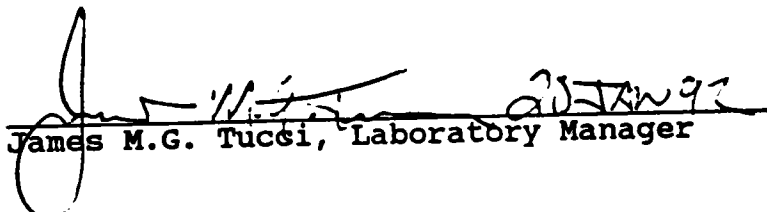
Benzene	ug/L	1	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	.6	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	2	1.0

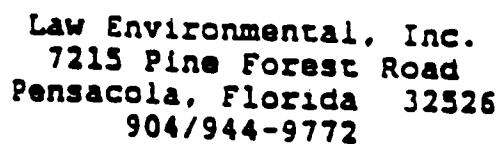
Multicomponent analysis: 2310-Fur. Metals W. EPA 7000

Lead	ug/L	32	2.0
2310-Furnace Dig W. EPA 3020		done	

Please advise should you have questions concerning these data.

Respectfully submitted,


James M.G. Tucci, Laboratory Manager



Analytical Request Form

To: _____
From: Bm Proctor Law Pab. 76
(Branch/Company Name)

Attn: Shipping / Receiving
(Dept or Name)

COC Number: 5295

Project Name: NCTs Cherry Pt

Project Number: 07174-04

Date Shipped: 12/24/91

Date results requested: 5/4

[illegible]

APPENDIX C

SOIL TEST BORING RECORDS, WELL CONSTRUCTION RECORDS AND GROUND WATER MONITORING WELL CONSTRUCTION SCHEMATICS

WELL CONSTRUCTION RECORD
13GW28

DRILLING CONTRACTOR LAW ENGINEERING, INC.
STATE WELL CONSTRUCTION PERMIT NUMBER: 24-0019-WM-0221
DRILLING REGISTRATION NUMBER 332

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ Pa. _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

1. WELL LOCATION: (Show sketch of the location below)
Nearest Town: Havelock County: Craven

Cherry Point MCAS
(Road, Community, or Subdivision and Lot No.)

2. OWNER: Commanding General, NREA

ADDRESS: Bldg. 198 Stop 1 MCAS
(Street or Route No.)
Cherry Point North Carolina 28533-5000
City or Town State Zip Code

3. DATE DRILLED 12/12/91 USE OF WELL Monitoring

4. TOTAL DEPTH 42.0'

5. CUTTINGS COLLECTED Yes X No

6. DOES WELL REPLACE EXISTING WELL? Yes No X

7. STATIC WATER LEVEL Below Top of Casing: 10.85 FT.
(Use "+" if Above Top of Casing)

8. TOP OF CASING IS 0 FT. ABOVE LAND SURFACE
*Casing terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118

9. YIELD (gpm) N/A METHOD OF TEST N/A

10. WATER ZONES (depth): N/A

11. CHLORINATION: Type N/A Amount N/A

12. CASING Wall Thickness
Depth Diameter or Weight/Ft. Material
From 0 To 32 Ft. 4" Sch 40 PVC
0 37 Ft. 2" Sch 40 PVC

13. GROUT: Depth Material Method
From 0 To 32 Ft. Portland Tremie
From 30 To 34 Ft. Bentonite Pour

14. SCREEN: Depth Diameter Slot Size Material
From 37 To 42 Ft. 2 in. 0.010 in. PVC
From To Ft. in. in.

15. SAND/GRAVEL PACK:
From 34 To 42 Ft. Torpedo Sand
From To Ft.

16. REMARKS:

Depth DRILLING LOG
From To Formation Description

See Attached

Test Boring (13GW29)

If additional space is needed use back of form.

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

See Drawing No. 3.2

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Thomas A. Poch
SIGNATURE OF CONTRACTOR OR AGENT

3/5/92
DATE

DRILLING CONTRACTOR, LAW ENGINEERING, INC.
STATE WELL CONSTRUCTION PERMIT NUMBER: 24-0019-WM-0221
DRILLING REGISTRATION NUMBER 332

- [illegible]

If additional space is needed use back of form.

(Show direction and distance from at least two State Roads, or other map reference points)

See Drawing No. 3.2

Thomas A. Peck
SIGNATURE OF CONTRACTOR OR AGENT

3/5/92
DATE

QUAD. NO. _____ SERIAL NO. _____
 Lat. _____ Long. _____ Po _____
 Minor Basin _____
 Basin Code _____
 Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD
13GW31

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ Po _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

DRILLING CONTRACTOR LAW ENGINEERING, INC.
STATE WELL CONSTRUCTION PERMIT NUMBER: 24-0019-WM-0221
DRILLING REGISTRATION NUMBER 332

1. WELL LOCATION: (Show sketch of the location below)
Nearest Town: Havelock County: Craven
Cherry Point MCAS
(Road, Community, or Subdivision and Lot No.)
2. OWNER: Commanding General, NREA

ADDRESS: Bldg. 198 Stop 1 MCAS
(Street or Route No.)
Cherry Point North Carolina 28533-5000
City or Town State Zip Code
3. DATE DRILLED 11/26/91 USE OF WELL Monitoring
4. TOTAL DEPTH 18.5'
5. CUTTINGS COLLECTED Yes X No
6. DOES WELL REPLACE EXISTING WELL? Yes No X
7. STATIC WATER LEVEL Below Top of Casing: 8 FT.
(Use " + " if Above Top of Casing)
8. TOP OF CASING IS 0 FT. ABOVE LAND SURFACE
*Casing terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118
9. YIELD (gpm) N/A METHOD OF TEST N/A
10. WATER ZONES (depth): N/A
11. CHLORINATION: Type N/A Amount N/A
12. CASING Wall Thickness
Depth Diameter or Weight/Ft. Material
From 0 To 3.5 Ft. 2" Sch 40 PVC
13. GROUT:
Depth Material Method
From 0 To 1.5 Ft. Portland Pour
From 1.5 To 2.5 Ft. Bentonite Pour
14. SCREEN:
Depth Diameter Slot Size Material
From 3.5 To 18.5 Ft. 2 in. 0.010 in. PVC
From To Ft. in. in.
15. SAND/GRAVEL PACK:
From 2.5 To 18.5 Ft. Torpedo Sand
From To Ft.
16. REMARKS: _____

Depth DRILLING LOG
From To Formation Description

See Attached
Test Boring (13GW31)

If additional space is needed use back of form.

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

See Drawing No. 3.2

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Thomas A. Puckett
SIGNATURE OF CONTRACTOR OR AGENT

3/5/92
DATE

LAW ENGINEERING

LAW ENGINEERING

10

Boring terminated at 42 feet.

LAW ENGINEERING

DEPTH
(FT.)

DESCRIPTION

ELEVATION
(FT.)

● PENETRATION - BLOWS/FOOT

0 10 20 30 40 60 80 100

42.0

Boring terminated at 42 feet.

14

REMARKS:

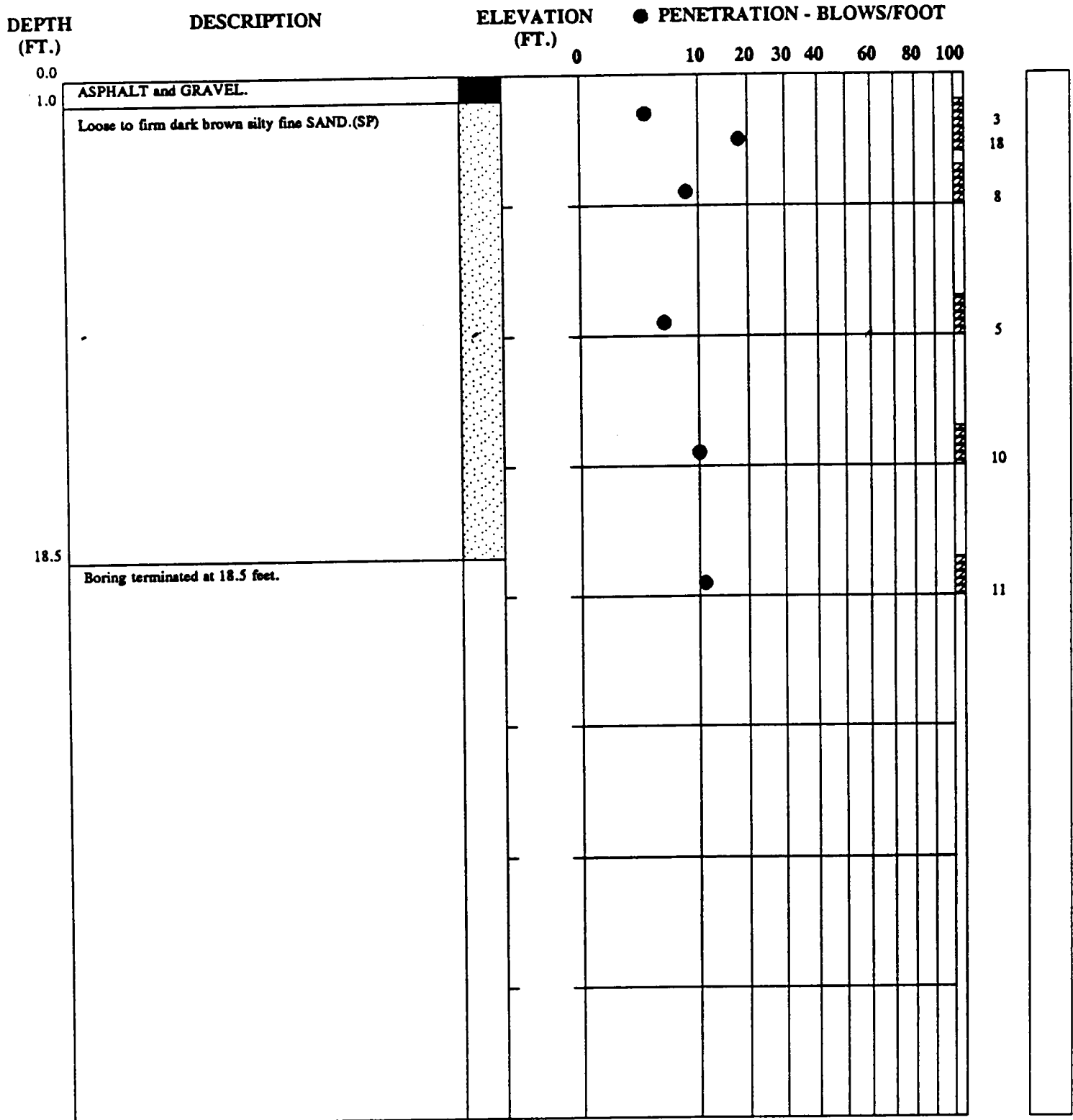
Boring terminated at 42 feet.

SEE KEY SHEET FOR EXPLANATION OF
SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD


BORING NUMBER 13GW29
DATE DRILLED December 12, 1991
PROJECT NUMBER 475-07174-04
PROJECT MCAS Cherry Point
PAGE 2 OF 2

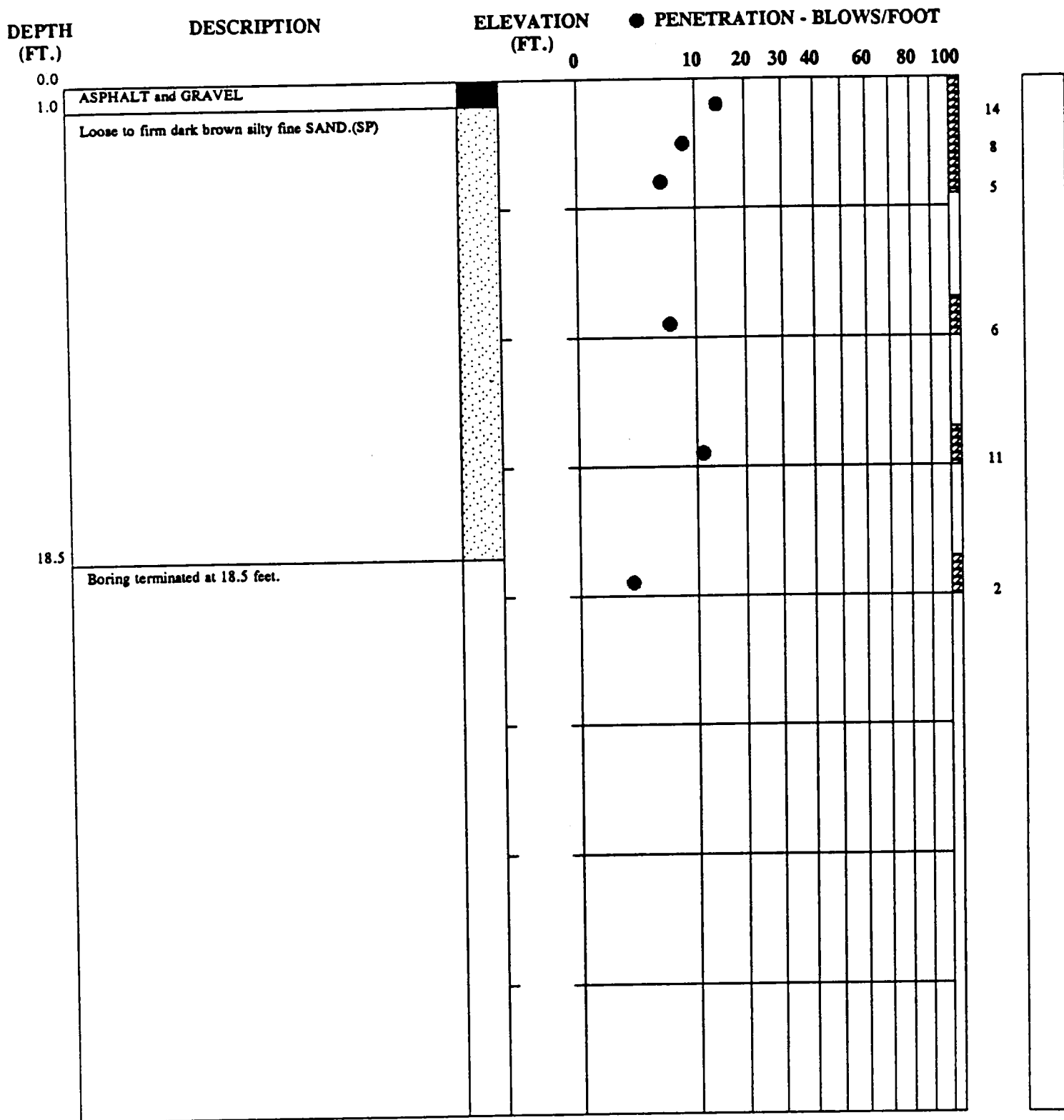
LAW ENGINEERING



REMARKS:
Boring terminated 18.5 feet.

SEE KEY SHEET FOR EXPLANATION OF
SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD	
BORING NUMBER	13GW30
DATE DRILLED	November 21, 1991
PROJECT NUMBER	475-07174-04
PROJECT	MCAS Cherry Point
PAGE 1 OF 1	
 LAW ENGINEERING	



REMARKS:

Boring terminated at 18.5 feet.

SEE KEY SHEET FOR EXPLANATION OF
SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER 13GW31
DATE DRILLED November 26, 1991
PROJECT NUMBER 475-07174-04
PROJECT MCAS Cherry Point
PAGE 1 OF 1

LAW ENGINEERING



A
RECEIVED BY

NOV 18 1991

State of North Carolina
Department of Environment, Health and Natural Resources
Northeastern Region
1424 Carolina Avenue, Washington, North Carolina 27889-1424

LAW ENGINEERING
RALEIGH

James C. Martin, Governor
William W. Cobey, Jr., Secretary

Lorraine G. Shinn
Regional Manager

DIVISION OF ENVIRONMENTAL MANAGEMENT

November 15, 1991

Commanding General
NREA (LN)
Building 198, Stop 1
Marine Corps Air Station
Cherry Point, North Carolina 28533-5000

SUBJECT: Well Construction Permit No.
24-0019-WM-0221
Craven County

Dear Sir:

In accordance with your application received November 7, 1991, we are forwarding herewith Well Construction Permit No. 24-0019-WM-0221, dated November 15, 1991, issued to Marine Corps Air Station, Cherry Point, North Carolina, for the construction of eighteen (18) monitoring wells located at Tank Farm "A", on the base, Cherry Point, North Carolina, in Craven County.

This Permit will be effective from the date of its issuance until May 15, 1992, and shall be subject to the conditions and limitations as specified therein.

If any parts, requirements, or limitations contained in this Permit are unacceptable to you, you have the right to an adjudicatory hearing before a hearing officer upon written demand to the Director within 30 days following receipt of this Permit, identifying the specified issues to be contended. Unless such demand is made, this Permit shall be final and binding.

Commanding General
Page 2
November 15, 1991

You will also find enclosed Well Construction Record(s) (GW-1) that must be filled out by the driller and submitted to the Department within 30 days upon completion of the well construction.

Sincerely,

ORIGINAL SIGNED BY
JIM MULLIGAN _

Jim Mulligan
Regional Supervisor

Enclosure

cc: W. Douglas Dixon ✓
Bob Cheek
Division of Coastal Management
KaRO

NORTH CAROLINA
ENVIRONMENTAL MANAGEMENT COMMISSION
DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
PERMIT FOR THE CONSTRUCTION OF A WELL OR WELL SYSTEM

In accordance with the provisions of Article 7, Chapter 87, North Carolina General Statutes, and other applicable Laws, Rules and Regulations,

PERMISSION IS HEREBY GRANTED TO
MARINE CORPS AIR STATION

FOR THE CONSTRUCTION OF eighteen (18) monitoring wells in the Surficial System located at Tank Farm "A", on the base, Cherry Point, North Carolina, in Craven County, in accordance with the application dated November 6, 1991, and in conformity with the specifications and supporting data, all of which are filed with the Department of Environment, Health, and Natural Resources and are considered a part of this permit.

This Permit is for well construction only, and does not waive any provisions or requirements of the Water Use Act of 1967, or any other applicable laws or regulations. Construction of a well under this Permit shall be in compliance with the North Carolina Well Construction Regulations and Standards, and any other laws and regulations pertaining to well construction. The issuance of this Permit shall not be interpreted as approval or acceptance as a necessary or reasonable expense for Trust Fund reimbursement purposes.

This Permit will be effective from the date of its issuance until May 15, 1992, and shall be subject to other specified conditions, limitations, or exceptions as follows:

1. The borehole shall not be drilled below the bottom of the unconfined aquifer unless a well is to be completed at a greater depth. If monitoring of both the confined and unconfined aquifers is desired, two separate wells shall be constructed.
2. The construction materials shall be compatible with the type of waste being monitored. Thermoplastic casing with threaded couplings where the threads form an integral part of the casing shall meet or exceed all the specifications for water well casing as classified by the American Society for Testing and Material (ASTM).

3. Well standards require that wells be grouted from land surface to a depth of twenty feet, except when zones or strata containing mineralized or polluted water are encountered. Monitor wells shall be grouted from land surface to a point near the top of the interval being monitored in order to insure that the sample is representative of the zone being monitored.

When it is desirable to monitor zones occurring at depths of less than 20 feet, the well shall be grouted from land surface to within two feet of the top of the screen in screened wells, and to the bottom of the casing in open-end wells. The top of the screen shall not be above the mean high seasonal water level.

4. The casing shall be installed with centering guides to provide for proper "gravel" envelope.
5. The "gravel pack" shall be placed around the screened wells and extended at least one foot above the well screen.
6. In "gravel" packed wells, a one-foot clay seal shall be placed on top of the "gravel" envelope.
7. The well(s) shall be grouted from land surface to the top of the clay seal.
8. All identification and completion requirements of the well standards shall apply. The entrance to the well shall be secured with a lock.
9. The well(s) shall be permanently labeled with a warning that it is for monitoring only and not to be used for water supply purposes. The location of the warning and size of the lettering shall be eye-catching.
10. All data including well construction reports (GW-1), water levels, water analysis, and other types of logs for each constructed well shall be submitted to the Department.
11. When a monitor well is no longer useful for its intended purpose or when its use is discontinued, it shall be properly abandoned and an abandonment report filed.
12. The Washington Regional Office shall be notified 24 hours prior to construction of the monitor well(s).

13. The well owner shall notify the Washington Regional Office upon completion of the monitor well(s).
14. Wells constructed below grade shall be designed to prevent down-hole contamination caused by fluid build-up in the wellhead box. The casing shall be extended to an elevation of slightly below the box cover and a drainage port be constructed in the box at an elevation slightly below the top of the casing. The wellhead shall be equipped with a water tight seal.

The above condition applies only to those wells located in areas where it is necessary to terminate the top of the casing at land surface in order to protect the well head (parking lots, driveways, etc.). All other wells shall comply with Rule 2C .0107(c)(5) Casing of the Well Construction Standards (NCAC 2C). The rule states, "The top of the casing shall be terminated by the drilling contractor at least 12 inches above land surface".

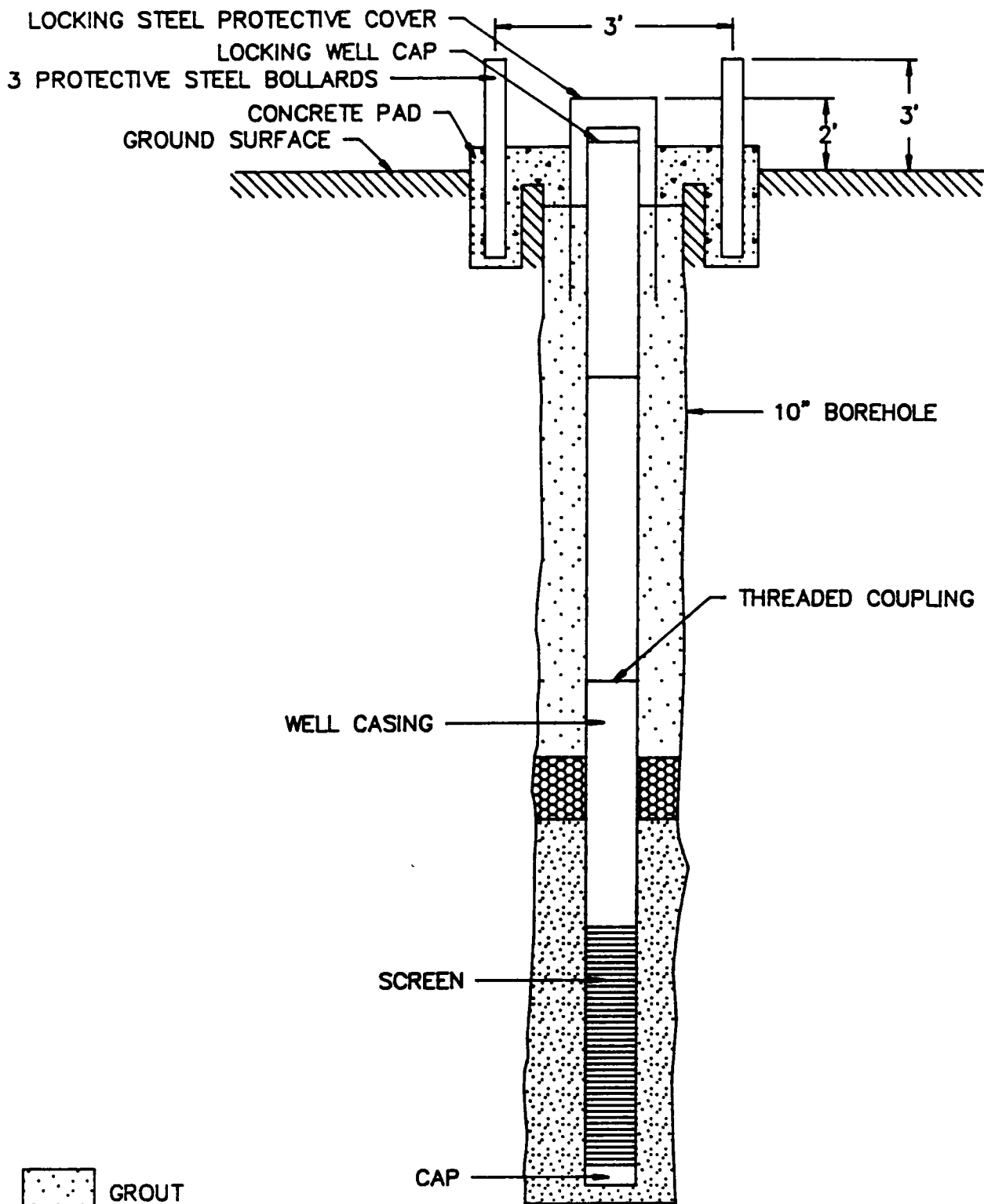
Permit issued this the 15th day of November, 1991.




NORTH CAROLINA ENVIRONMENTAL MANAGEMENT COMMISSION

ORIGINAL SIGNED BY
JIM MULLIGAN

Jim Mulligan, Regional Supervisor
Division of Environmental Management
By Authority of the
Environmental Management Commission

PERMIT NO. 24-0019-WM-0221



-  GROUT
-  BENTONITE
-  GRANULAR BACKFILL

DEPT4756



LAW ENGINEERING
RALEIGH, NORTH CAROLINA

TYPE II MONITORING WELL SCHEMATIC

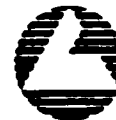
DRAWN: <i>DCC</i>	DATE: feb. 1992
DFT CHECK: <i>DCC</i>	SCALE: NOT TO SCALE
ENG CHECK: <i>JAP</i>	JOB NO. 475-07174-04
APPROVAL:	DWG NO.

REFERENCE DWGS:

APPENDIX D

SOIL LABORATORY ANALYTICAL TEST RESULTS

Law Environmental, Inc.
Pensacola Branch
7215 Pine Forest Road
Pensacola, Florida 32526



December 23, 1991

Mr. Chris Cornelissen
Law Engineering, Inc.
3301 Atlantic Avenue
Raleigh, NC 27604
Clt #12024 Proj #475-07174-04

Dear Mr. Cornelissen:

Below are results of analysis of 2 samples received for examination on December 5, 1991:

Location code: CP6A Loc. Desc.: 13GW26-S5;
LAB I.D. AA15883 P.O./Project No.: 47507174 Client No.: 12024
Collection Date: 12/04/91 Collection Time: 14:00
Submittal Date: 12/05/91 Submittal Time: 16:31
Sample collector: PULLEY

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
Multicomponent analysis: 2321-TPHVS Cal-DHS			
Gasoline	mg/Kg	4.6 done	0.2
2323-Tot. Pet. Hydro. Prep. Soil			
Multicomponent analysis: 2321-TPHXS Cal-DHS			
Diesel	mg/Kg	Not Det done	4.0
2310-LDRL Ext. Met. S. EPA 1311			
Multicomponent analysis: 2310-LDRL Metals EPA 6010			
Lead	ug/L	Not Det	21.0
2310-pH by EPA 9040 Soil	units 2-12	7.5	
2310-Ignitability EPA 1010	degrees F	200	75

Comments:

Ignitability should be considered greater than 200 degrees.

Location code: CP6A Loc. Desc.: 13GW26-S6
LAB I.D. AA15884 P.O./Project No.: 47507174 Client No.: 12024
Collection Date: 12/04/91 Collection Time: 14:10
Submittal Date: 12/05/91 Submittal Time: 16:31
Sample collector: PULLEY

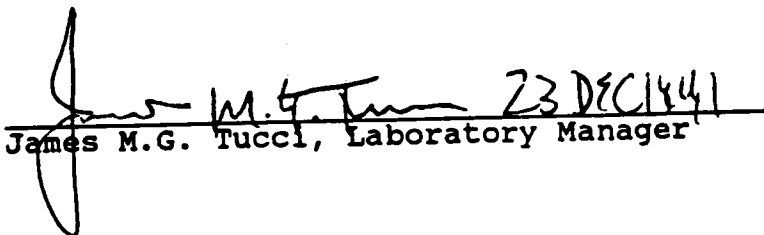
TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Mr. Chris Cornelissen
Page: 2
December 23, 1991

Multicomponent analysis: 2321-TPHVS Cal-DHS		
Gasoline	mg/Kg	0.2
2323-Tot. Pet. Hydro. Prep. Soil	Not Det done	
Multicomponent analysis: 2321-TPHXS Cal-DHS		
Diesel	mg/Kg	4.0
2310-LDRL Ext. Met. S. EPA 1311	Not Det done	
Multicomponent analysis: 2310-LDRL Metals EPA 6010		
Lead	ug/L	23 21.0

Please advise should you have questions concerning these data.

Respectfully submitted,


James M.G. Tucci, Laboratory Manager 23 DEC 1991

Law Environmental, Inc.
Pensacola Branch
7215 Pine Forest Road
Pensacola, Florida 32526



January 10, 1992

Mr. Chris Cornelissen
Law Engineering, Inc.
3301 Atlantic Avenue
Raleigh, NC 27604
Clt. #12024 Proj. #475-07174-04

Dear Mr. Cornelissen:

Below are results of analysis of 2 samples received for examination on November 23, 1991:

Location code: CP2 Loc. Desc.: ~~13GW27 S2~~
LAB I.D. AA15574 P.O./Project No.: 0717404 Client No.: 12024
Collection Date: 11/22/91 Collection Time: 13:20
Submittal Date: 11/23/91 Submittal Time: 12:09
Sample collector: CORNELISSEN

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
Multicomponent analysis: 2321-TPHVS Cal-DHS Gasoline	mg/Kg	Not Det	0.2
Multicomponent analysis: 2321-TPHXS Cal-DHS Diesel	mg/Kg	Not Det	4.0
2323-Tot. Pet. Hydro. Prep. Soil		done	
2310-LDRL Ext. Met. S. EPA 1311		done	
Multicomponent analysis: 2310-LDRL Metals EPA 6010 Lead	ug/L	Not Det	21.0

Location code: CP2 Loc. Desc.: ~~13GW27 S4~~
LAB I.D. AA15575 P.O./Project No.: 0717404 Client No.: 12024
Collection Date: 11/22/91 Collection Time: 13:20
Submittal Date: 11/23/91 Submittal Time: 12:09
Sample collector: CORNELISSEN

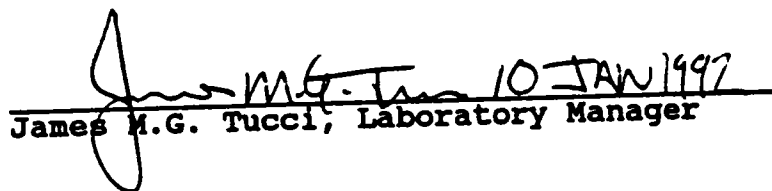
TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Mr. Chris Cornelissen
Page: 2
January 10, 1992

Multicomponent analysis: 2321-TPHVS Cal-DHS Gasoline	mg/Kg	8	0.2
Multicomponent analysis: 2321-TPHXS Cal-DHS Diesel	mg/Kg	Not Det done	4.0
2323-Tot. Pet. Hydro. Prep. Soil		done	
2310-LDRL Ext. Met. S. EPA 1311			
Multicomponent analysis: 2310-LDRL Metals EPA 6010 Lead	ug/L	Not Det	21.0

Please advise should you have questions concerning these data.

Respectfully submitted,


James M.G. Tucci, Laboratory Manager



Comments:

Law Environmental, Inc.
Pensacola Branch
7215 Pine Forest Road
Pensacola, Florida 32526



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DEC 27 1991

December 26, 1991

Mr. Randy Pulley
Law Engineering, Inc.
3301 Atlantic Avenue
Raleigh, NC 27604
Clt.#12024 Proj.#475-07174-04

LAW ENGINEERING
RALEIGH

Dear Mr. Pulley:

Below are results of analysis of 4 samples received for examination
on December 11, 1991:

Location code: CP10 Loc. Desc.: 13GW29S4
LAB I.D. AA16043 P.O./Project No.: 47507174 Client No.: 12024
Collection Date: 12/10/91
Submittal Date: 12/11/91 Submittal Time: 17:43
Sample collector: PROCTOR

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
Multicomponent analysis: 2321-TPHVS Cal-DHS			
Gasoline	mg/Kg	Not Det done	50.0
2323-Tot. Pet. Hydro. Prep. Soil			
Multicomponent analysis: 2321-TPHXS Cal-DHS			
Diesel	mg/Kg	<220 done	150.0
2310-LDRL Ext. Met. S. EPA 1311			
Multicomponent analysis: 2310-LDRL Metals EPA 6010			
Lead	ug/L	Not Det	21.0

Location code: CP10 Loc. Desc.: 13GW29S5
LAB I.D. AA16044 P.O./Project No.: 47507174 Client No.: 12024
Collection Date: 12/10/91
Submittal Date: 12/11/91 Submittal Time: 17:43
Sample collector: PROCTOR

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
-------------------	-------	----------------	--------------------

Multicomponent analysis: 2321-TPHVS Cal-DHS

Mr. Randy Pulley
Page: 2
December 26, 1991

2321-TPHVS Cal-DHS (continued):
Gasoline mg/Kg Not Det 20.0
done
2323-Tot. Pet. Hydro. Prep. Soil
Multicomponent analysis: 2321-TPHXS Cal-DHS
Diesel mg/Kg ~~2300~~ 600.0
done
2310-LDRL Ext. Met. S. EPA 1311
Multicomponent analysis: 2310-LDRL Metals EPA 6010
Lead ug/L Not Det 21.0

Location code: CP10 Loc. Desc.: 13GW28S5
LAB I.D. AA16045 P.O./Project No.: 47507174 Client No.: 12024
Collection Date: 12/10/91
Submittal Date: 12/11/91 Submittal Time: 17:43
Sample collector: PROCTOR

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
Multicomponent analysis: 2321-TPHVS Cal-DHS			
Gasoline	mg/Kg	Not Det	0.2
2323-Tot. Pet. Hydro. Prep. Soil		done	
Multicomponent analysis: 2321-TPHXS Cal-DHS			
Diesel	mg/Kg	Not Det	3.0
2310-LDRL Ext. Met. S. EPA 1311		done	
Multicomponent analysis: 2310-LDRL Metals EPA 6010			
Lead	ug/L	Not Det	21.0

Location code: CP10 Loc. Desc.: 13GW28S6
LAB I.D. AA16046 P.O./Project No.: 47507174 Client No.: 12024
Collection Date: 12/10/91
Submittal Date: 12/11/91 Submittal Time: 17:43
Sample collector: PROCTOR

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
Multicomponent analysis: 2321-TPHVS Cal-DHS			
Gasoline	mg/Kg	Not Det	0.2
2323-Tot. Pet. Hydro. Prep. Soil		done	

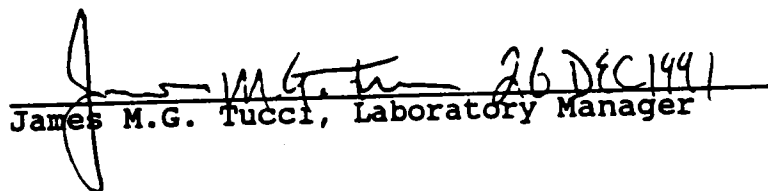
Mr. Randy Pulley
Page: 3
December 26, 1991

Sample AA16046 (continued)

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
Multicomponent analysis: 2321-TPHXS Cal-DHS Diesel 2310-LDRL Ext. Met. S. EPA 1311	mg/Kg	Not Det done	3.0
Multicomponent analysis: 2310-LDRL Metals EPA 6010 Lead	ug/L	Not Det	21.0

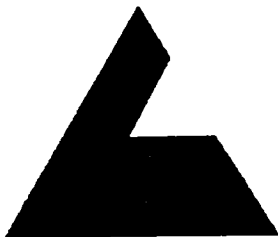
Please advise should you have questions concerning these data.

Respectfully submitted,


James M.G. Tucci, Laboratory Manager

APPENDIX E

MONITORING WELL CASING AND WATER ELEVATION WORKSHEETS



LAW ENGINEERING
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA 27604

ENVIRONMENTAL DEPARTMENT

MONITORING WELL CASING AND WATER ELEVATION WORKSHEET

PROJECT NAME MCAS Cherry Point

JOB NUMBER 475-07174-04

LOCATION Tank Farm A

DATE 12/19/91

DESCRIPTION OF SURVEY DATUM Benchmark I.D. 4-90; Elevation = 23.49 MSL

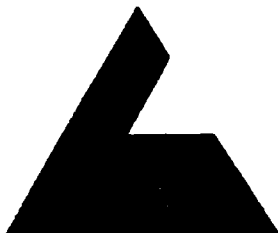
FIELD PERSONNEL Proctor, Woody

MEASURING DEVICE(S) MMC Oil-Water Interface Probe Model D-2401-201

*See Worksheet for Measuring Point Calculation Data

WELL NUMBER	MEASURING POINT CALCULATIONS			DEPTH TO WATER (FT)	ELEV OF WATER (FT)	PRODUCT THICKNESS (FT)	COMMENTS (ODOR, WELL COND., PROTECTIVE COVER CONDITION)
	ROD HEIGHT (FT)	INSTRUMENT HEIGHT (FT)	ELEV OF MEASURING POINT (1) (FT)				
13GW1			25.31			2.97	
13GW2			23.85			3.75	
13GW3			25.21			1.92	
13GW4			27.62			2.66	
13GW5			25.74	10.51	15.23	ND	
13GW6			23.67			1.0	
13GW7			23.50	9.09	14.41	ND	
13GW8			25.10	10.52	14.58	ND	
13GW9			21.01	7.40	13.61	ND	
13GW10			24.47			2.64	
13GW11			24.56	10.65	13.91	ND	
13GW12			24.84	9.63	15.21	ND	
13GW13			22.69	7.71	15.18	ND	
13GW14			21.47			2.11	
13GW15			28.31	14.94	13.37	ND	

(1) Measuring point top of casing unless otherwise noted.
ND None Detected



LAW ENGINEERING
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA 27604

ENVIRONMENTAL DEPARTMENT

MONITORING WELL CASING AND WATER ELEVATION WORKSHEET

PROJECT NAME MCAS Cherry Point JOB NUMBER 476-07174-04

LOCATION Tank Farm A DATE 12/19/91

DESCRIPTION OF SURVEY DATUM Benchmark I.D. 4-90; Elevation = 23.49 MSL

FIELD PERSONNEL Proctor, Woody

MEASURING DEVICE(S) MMC Oil-Water Interface Probe Model D-2401-201

*See Worksheet for Measuring Point Calculation Data

WELL NUMBER	MEASURING POINT CALCULATIONS			DEPTH TO WATER (FT)	ELEV OF WATER (FT)	PRODUCT THICKNESS (FT)	COMMENTS (ODOR, WELL COND., PROTECTIVE COVER CONDITION)
	ROD HEIGHT (FT)	INSTRUMENT HEIGHT (FT)	ELEV OF MEASURING POINT (1) (FT)				
13GW16			27.54	15.02	12.52	ND	
13GW17			24.07	9.45	14.62	ND	
13GW18			23.64	8.67	14.97	ND	
13GW19			24.21	9.94	14.27	ND	
13GW20			23.80	10.27	13.53	ND	
13GW21			24.79	11.90	12.89	ND	
13GW22			22.57			ND	Covered by Equipment
13GW23			26.76	11.40	15.36	ND	
13GW24			23.42	10.94	12.48	ND	
13GW25			25.80	13.46	12.34	ND	
13GW26			23.24	9.31	13.93	ND	
13GW27			21.47	8.06	13.41	ND	
13GW28			23.34	10.85	12.49	ND	
13GW29			25.73	12.12	13.61	ND	
13GW30			23.51	8.35	15.16	ND	
13GW31			23.11	7.94	15.17	ND	

(1) Measuring point top of casing unless otherwise noted.
ND None Detected

APPENDIX F

MONITORING WELL AND SAMPLING FIELD DATA WORKSHEETS AND CHAIN OF CUSTODY RECORDS



LAW ENGINEERING
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA 27604

MONITORING WELL AND SAMPLING
FIELD DATA WORKSHEET

DEVELOPMENT

LAW JOB NUMBER 07174-04 MONITORING WELL NUMBER 13GW26

SITE NAME MCAS CHERRY POINT, TANK FARM "A"

DATE (MO/DAY/YR) 12/12/91 TIME (MILITARY) 0730

FIELD PERSONNEL PROCTOR, WOODY

WEATHER CONDITIONS SUNNY, COOL

TOTAL WELL DEPTH (TWD) 23.5' 1/10 FT. (DEPTH BELOW MEASURING POINT)

HEIGHT OF MEASURING POINT ABOVE LAND SURFACE N/A 1/10 FT.

DESCRIPTION OF MEASURING POINT TOP OF CASING

DEPTH TO GROUNDWATER (DGW) 9.3' 1/100 FT. (DEPTH BELOW MEASURING POINT)

LENGTH OF WATER COLUMN (LWC) = TWD - DGW = 14.2 1/100 FT.

ONE STANDING WELL VOLUME (SWV) = LWC X 0.16 = 2.3 1/10 GAL.

THREE STANDING WELL VOLUMES = 3XSWV = 6.8 1/10 GAL = STANDARD EVACUATION VOLUME

METHOD OF WELL EVACUATION TEFLON BAILER OTHER: ARCH PUMP

TOTAL VOLUME OF WATER REMOVED 40 1/10 GAL. CASING DIAMETER 2 in.

CASING MATERIAL PVC X S.S. TEFLON OTHER

SCREENED INTERVAL (FROM ID PLATE) 8.5 - 23.5 (DEPTHS BELOW LAND SURFACE - FT.)

STEEL GUARD PIPE AROUND CASING YES NO X COMMENTS
LOCKING CAP YES X NO

PROTECTIVE POST/ABUTMENT YES NO X

NONPOTABLE LABEL YES X NO

ID PLATE YES X NO

WELL INTEGRITY SATISFACTORY YES X NO

WELL YIELD LOW MODERATE X HIGH COMMENTS

FIELD ANALYSES

VOLUME (1/10 GAL.)	20	30	35	40
pH (S.U.)	5.47	5.47	5.54	5.54
SP. COND. (μ MHOS/CM)	496	467	470	473
WATER TEMP. (°C)	22.8	22.3	22.7	22.8
TURBIDITY*	2	1	1	1

* VISUAL DETERMINATION ONLY
(1) CLEAR (2) SLIGHT (3) MODERATE (4) HIGH



LAW ENGINEERING
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA 27604

MONITORING WELL AND SAMPLING
FIELD DATA WORKSHEET

DEVELOPMENT

LAW JOB NUMBER 07174-04 MONITORING WELL NUMBER 13GW27

SITE NAME MCAS CHERRY POINT, TANK FARM "A"

DATE (MO/DAY/YR) 12/13/91 TIME (MILITARY) 1200

FIELD PERSONNEL PROCTOR, WOODY

WEATHER CONDITIONS PARTLY CLOUDY, MILD

TOTAL WELL DEPTH (TWD) 14.0' 1/10 FT. (DEPTH BELOW MEASURING POINT)

HEIGHT OF MEASURING POINT ABOVE LAND SURFACE N/A 1/10 FT.

DESCRIPTION OF MEASURING POINT TOP OF CASING

DEPTH TO GROUNDWATER (DGW) 8.06 1/100 FT. (DEPTH BELOW MEASURING POINT)

LENGTH OF WATER COLUMN (LWC) = TWD - DGW = 5.94 1/100 FT.

ONE STANDING WELL VOLUME (SWV) = LWC X 0.16 = 0.95 1/10 GAL.

THREE STANDING WELL VOLUMES = 3XSWV = 3 1/10 GAL = STANDARD EVACUATION VOLUME

METHOD OF WELL EVACUATION TEFLON BAILER OTHER: ARCH PUMP

TOTAL VOLUME OF WATER REMOVED 15 1/10 GAL. CASING DIAMETER 2 in.

CASING MATERIAL PVC X S.S. TEFLON OTHER

SCREENED INTERVAL (FROM ID PLATE) 4 - 14 (DEPTHS BELOW LAND SURFACE - FT.)

STEEL GUARD PIPE AROUND CASING YES NO X COMMENTS
LOCKING CAP YES X NO

PROTECTIVE POST/ABUTMENT YES NO X

NONPOTABLE LABEL YES X NO

ID PLATE YES X NO

WELL INTEGRITY SATISFACTORY YES X NO

WELL YIELD LOW MODERATE HIGH X COMMENTS

FIELD ANALYSES

VOLUME (1/10 GAL.)	5	10	15	
pH (S.U.)	6.92	5.90	5.95	
SP. COND. (μMHOS/CM)	870	632	612	
WATER TEMP. (°C)	20.8	20.8	20.8	
TURBIDITY*	4	3	3	

*VISUAL DETERMINATION ONLY
(1) CLEAR (2) SLIGHT (3) MODERATE (4) HIGH



LAW ENGINEERING
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA 27604

MONITORING WELL AND SAMPLING
FIELD DATA WORKSHEET

DEVELOPMENT

LAW JOB NUMBER 07174-04 MONITORING WELL NUMBER 13GW28

SITE NAME MCAS CHERRY POINT, TANK FARM "A"

DATE (MO/DAY/YR) 12/16/91 TIME (MILITARY) 1330

FIELD PERSONNEL PROCTOR, WOODY

WEATHER CONDITIONS COLD, CLEAR

TOTAL WELL DEPTH (TWD) 42.5' 1/10 FT. (DEPTH BELOW MEASURING POINT)

HEIGHT OF MEASURING POINT ABOVE LAND SURFACE N/A 1/10 FT.

DESCRIPTION OF MEASURING POINT TOP OF CASING

DEPTH TO GROUNDWATER (DGW) 10.85 1/100 FT. (DEPTH BELOW MEASURING POINT)

LENGTH OF WATER COLUMN (LWC) = TWD - DGW = 31.65 1/100 FT.

ONE STANDING WELL VOLUME (SWV) = LWC X 0.16 = 5.0 1/10 GAL.

THREE STANDING WELL VOLUMES = 3XSWV = 15 1/10 GAL = STANDARD EVACUATION VOLUME

METHOD OF WELL EVACUATION TEFLON BAILER OTHER: ARCH PUMP

TOTAL VOLUME OF WATER REMOVED 16 1/10 GAL. CASING DIAMETER 2 in.

CASING MATERIAL PVC X S.S. TEFLON OTHER

SCREENED INTERVAL (FROM ID PLATE) 37.5 - 42.5 (DEPTHS BELOW LAND SURFACE - FT.)

STEEL GUARD PIPE AROUND CASING YES NO X COMMENTS
LOCKING CAP YES X NO

PROTECTIVE POST/ABUTMENT YES NO X

NONPOTABLE LABEL YES X NO

ID PLATE YES X NO

WELL INTEGRITY SATISFACTORY YES X NO

WELL YIELD LOW X MODERATE HIGH COMMENTS

FIELD ANALYSES

VOLUME (1/10 GAL.)	9	11	14	16
pH (S.U.)	10.9	9.79	9.1	9.0
SP. COND. (μMHOS/CM)	1740	1220	1230	1242
WATER TEMP. (C)	21.2	20.9	21.0	21.7
TURBIDITY*	1	1	1	1

*VISUAL DETERMINATION ONLY
(1) CLEAR (2) SLIGHT (3) MODERATE (4) HIGH



LAW ENGINEERING
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA 27604

MONITORING WELL AND SAMPLING
FIELD DATA WORKSHEET

DEVELOPMENT

LAW JOB NUMBER 07174-04 MONITORING WELL NUMBER 13GW29

SITE NAME MCAS CHERRY POINT, TANK FARM "A"

DATE (MO/DAY/YR) 12/16/91 TIME (MILITARY) 1630

FIELD PERSONNEL PROCTOR, WOODY

WEATHER CONDITIONS COLD, CLEAR

TOTAL WELL DEPTH (TWD) 42.5' 1/10 FT. (DEPTH BELOW MEASURING POINT)

HEIGHT OF MEASURING POINT ABOVE LAND SURFACE 2.5' 1/10 FT.

DESCRIPTION OF MEASURING POINT TOP OF CASING

DEPTH TO GROUNDWATER (DGW) 12.13 1/100 FT. (DEPTH BELOW MEASURING POINT)

LENGTH OF WATER COLUMN (LWC) = TWD - DGW = 30.37 1/100 FT.

ONE STANDING WELL VOLUME (SWV) = LWC X 0.16 = 4.9 1/10 GAL.

THREE STANDING WELL VOLUMES = 3XSWV = 14.7 1/10 GAL = STANDARD EVACUATION VOLUME

METHOD OF WELL EVACUATION TEFLON BAILER OTHER: ARCH PUMP

TOTAL VOLUME OF WATER REMOVED 75 1/10 GAL. CASING DIAMETER 2 in.

CASING MATERIAL PVC S.S. TEFLON OTHER

SCREENED INTERVAL (FROM ID PLATE) 37.5 - 42.5 (DEPTHS BELOW LAND SURFACE - FT.)

STEEL GUARD PIPE AROUND CASING YES NO X COMMENTS

LOCKING CAP YES X NO

PROTECTIVE POST/ABUTMENT YES X NO

NONPOTABLE LABEL YES X NO

ID PLATE YES X NO

WELL INTEGRITY SATISFACTORY YES X NO

WELL YIELD LOW MODERATE HIGH X COMMENTS

FIELD ANALYSES

VOLUME (1/10 GAL.)	50	60	70	75
pH (S.U.)	9.30	8.50	8.90	8.90
SP. COND. (μMHOS/CM)	619	540	555	538
WATER TEMP. (°C)	19.5	20.3	19.7	19.7
TURBIDITY*	3	3	3	3

*VISUAL DETERMINATION ONLY
(1) CLEAR (2) SLIGHT (3) MODERATE (4) HIGH



LAW ENGINEERING
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA 27604

MONITORING WELL AND SAMPLING
FIELD DATA WORKSHEET

PURGING

LAW JOB NUMBER 07174-04 MONITORING WELL NUMBER 13GW26

SITE NAME MCAS CHERRY POINT, TANK FARM "A"

DATE (MO/DAY/YR) 12/19/91 TIME (MILITARY) 14:00

FIELD PERSONNEL WOODY

WEATHER CONDITIONS COLD, CLEAR

TOTAL WELL DEPTH (TWD) 23.5' 1/10 FT. (DEPTH BELOW MEASURING POINT)

HEIGHT OF MEASURING POINT ABOVE LAND SURFACE N/A 1/10 FT.

DESCRIPTION OF MEASURING POINT TOP OF CASING

DEPTH TO GROUNDWATER (DGW) 9.3 1/100 FT. (DEPTH BELOW MEASURING POINT)

LENGTH OF WATER COLUMN (LWC) = TWD - DGW = 13.7 1/100 FT.

ONE STANDING WELL VOLUME (SWV) = LWC X 0.17 = 2.3 1/10 GAL.

THREE STANDING WELL VOLUMES = 3XSWV = 6.9 1/10 GAL = STANDARD EVACUATION VOLUME

METHOD OF WELL EVACUATION TEFLON BAILER X OTHER: _____

TOTAL VOLUME OF WATER REMOVED 7.5 1/10 GAL. CASING DIAMETER 2 in.

CASING MATERIAL PVC X S.S. _____ TEFLON _____ OTHER _____

SCREENED INTERVAL (FROM ID PLATE) _____ (DEPTHS BELOW LAND SURFACE - FT.)

STEEL GUARD PIPE AROUND CASING YES _____ NO X COMMENTS _____

LOCKING CAP YES X NO _____

PROTECTIVE POST/ABUTMENT YES _____ NO X

NONPOTABLE LABEL YES _____ NO X

ID PLATE YES X NO _____

WELL INTEGRITY SATISFACTORY YES X NO _____

WELL YIELD LOW _____ MODERATE X HIGH _____ COMMENTS _____

FIELD ANALYSES

VOLUME (1/10 GAL.)	0	3.5	7.5	
pH (S.U.)	7.81	7.95	7.75	
SP. COND. (μMHOS/CM)	538	542	549	
WATER TEMP. (°C)	17.6	17.3	17.9	
TURBIDITY*	4	4	4	

*VISUAL DETERMINATION ONLY
(1) CLEAR (2) SLIGHT (3) MODERATE (4) HIGH



LAW ENGINEERING
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RALEIGH, NORTH CAROLINA 27604

MONITORING WELL AND SAMPLING
FIELD DATA WORKSHEET

PURGING

LAW JOB NUMBER 07174-04 MONITORING WELL NUMBER 13GW27

SITE NAME MCAS CHERRY POINT, TANK FARM "A"

DATE (MO/DAY/YR) 12/19/91 TIME (MILITARY) _____

FIELD PERSONNEL PROCTOR, WOODY

WEATHER CONDITIONS COLD, CLEAR

TOTAL WELL DEPTH (TWD) 14.0' 1/10 FT. (DEPTH BELOW MEASURING POINT)

HEIGHT OF MEASURING POINT ABOVE LAND SURFACE N/A 1/10 FT.

DESCRIPTION OF MEASURING POINT TOP OF CASING

DEPTH TO GROUNDWATER (DGW) 8.06 1/100 FT. (DEPTH BELOW MEASURING POINT)

LENGTH OF WATER COLUMN (LWC) = TWD - DGW = 5.94 1/100 FT.

ONE STANDING WELL VOLUME (SWV) = LWC X 0.16 = 0.95 1/10 GAL.

THREE STANDING WELL VOLUMES = 3XSWV = 3 1/10 GAL = STANDARD EVACUATION VOLUME

METHOD OF WELL EVACUATION TEFLON BAILER X OTHER: _____

TOTAL VOLUME OF WATER REMOVED 2.5 1/10 GAL. CASING DIAMETER 2 in.

CASING MATERIAL PVC X S.S. _____ TEFLON _____ OTHER _____

SCREENED INTERVAL (FROM ID PLATE) 4 - 14 (DEPTHS BELOW LAND SURFACE - FT.)

STEEL GUARD PIPE AROUND CASING YES _____ NO X COMMENTS _____
LOCKING CAP YES X NO _____

PROTECTIVE POST/ABUTMENT YES _____ NO X _____

NONPOTABLE LABEL YES X NO _____

ID PLATE YES X NO _____

WELL INTEGRITY SATISFACTORY YES X NO _____

WELL YIELD LOW _____ MODERATE _____ HIGH X COMMENTS Dry after 2.5 gallons

FIELD ANALYSES

VOLUME (1/10 GAL.)	0	2.5		
pH (S.U.)	7.83	7.59		
SP. COND. (μMHOS/CM)	800	820		
WATER TEMP. (°C)	20.9	21.4		
TURBIDITY*	4	4		

*VISUAL DETERMINATION ONLY
(1) CLEAR (2) SLIGHT (3) MODERATE (4) HIGH



LAW ENGINEERING
3301 ATLANTIC AVENUE
RALEIGH, NORTH CAROLINA 27604

MONITORING WELL AND SAMPLING
FIELD DATA WORKSHEET

PURGING

LAW JOB NUMBER 07174-04 MONITORING WELL NUMBER 13GW28

SITE NAME MCAS CHERRY POINT, TANK FARM "A"

DATE (MO/DAY/YR) 12/19/91 TIME (MILITARY) 1510

FIELD PERSONNEL PROCTOR, WOODY

WEATHER CONDITIONS COLD, CLEAR

TOTAL WELL DEPTH (TWD) 42.5' 1/10 FT. (DEPTH BELOW MEASURING POINT)

HEIGHT OF MEASURING POINT ABOVE LAND SURFACE N/A 1/10 FT.

DESCRIPTION OF MEASURING POINT TOP OF CASING

DEPTH TO GROUNDWATER (DGW) 10.85 1/100 FT. (DEPTH BELOW MEASURING POINT)

LENGTH OF WATER COLUMN (LWC) = TWD - DGW = 31.65 1/100 FT.

ONE STANDING WELL VOLUME (SWV) = LWC X 0.16 = 5.0 1/10 GAL.

THREE STANDING WELL VOLUMES = 3XSWV = 15.0 1/10 GAL = STANDARD EVACUATION VOLUME

METHOD OF WELL EVACUATION TEFLON BAILER X OTHER: _____

TOTAL VOLUME OF WATER REMOVED 17.5 1/10 GAL. CASING DIAMETER 2 in.

CASING MATERIAL PVC X S.S. _____ TEFLON _____ OTHER _____

SCREENED INTERVAL (FROM ID PLATE) 37.5 - 42.5 (DEPTHS BELOW LAND SURFACE - FT.)

STEEL GUARD PIPE AROUND CASING YES _____ NO X COMMENTS _____
LOCKING CAP YES X NO _____

PROTECTIVE POST/ABUTMENT YES _____ NO _____

NONPOTABLE LABEL YES X NO _____

ID PLATE YES X NO _____

WELL INTEGRITY SATISFACTORY YES X NO _____

WELL YIELD LOW _____ MODERATE _____ HIGH X COMMENTS _____

FIELD ANALYSES

VOLUME (1/10 GAL.)	10	12.5	15	17.5
pH (S.U.)	10.30	10.28	10.30	10.15
SP. COND. (μMHOS/CM)	670	623	630	639
WATER TEMP. (°C)	16.0	15.6	15.8	15.9
TURBIDITY*	3	3	3	3

*VISUAL DETERMINATION ONLY
(1) CLEAR (2) SLIGHT (3) MODERATE (4) HIGH



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RALEIGH, NORTH CAROLINA 27604

MONITORING WELL AND SAMPLING
FIELD DATA WORKSHEET

LAW JOB NUMBER 07174-04 MONITORING WELL NUMBER 13GW29 PURGING

SITE NAME MCAS CHERRY POINT, TANK FARM "A"

DATE (MO/DAY/YR) 12/19/91 TIME (MILITARY) 1510

FIELD PERSONNEL PROCTOR, WOODY

WEATHER CONDITIONS COLD, CLEAR

TOTAL WELL DEPTH (TWD) 42.5' 1/10 FT. (DEPTH BELOW MEASURING POINT)

HEIGHT OF MEASURING POINT ABOVE LAND SURFACE 2.5' 1/10 FT.

DESCRIPTION OF MEASURING POINT TOP OF CASING

DEPTH TO GROUNDWATER (DGW) 12.13' 1/100 FT. (DEPTH BELOW MEASURING POINT)

LENGTH OF WATER COLUMN (LWC) = TWD - DGW = 30.37 1/100 FT.

ONE STANDING WELL VOLUME (SWV) = LWC X 0.16 = 4.9 1/10 GAL.

THREE STANDING WELL VOLUMES = 3XSWV = 14.7 1/10 GAL = STANDARD EVACUATION VOLUME

METHOD OF WELL EVACUATION TEFLON BAILER X OTHER: _____

TOTAL VOLUME OF WATER REMOVED 15 1/10 GAL. CASING DIAMETER 2 in.

CASING MATERIAL PVC X S.S. _____ TEFLON _____ OTHER _____

SCREENED INTERVAL (FROM ID PLATE) 37.5 - 42.5 (DEPTHS BELOW LAND SURFACE - FT.)

STEEL GUARD PIPE AROUND CASING YES _____ NO X COMMENTS _____

LOCKING CAP YES X NO _____

PROTECTIVE POST/ABUTMENT YES X NO _____

NONPOTABLE LABEL YES X NO _____

ID PLATE YES X NO _____

WELL INTEGRITY SATISFACTORY YES X NO _____

WELL YIELD LOW _____ MODERATE _____ HIGH X COMMENTS _____

FIELD ANALYSES

VOLUME (1/10 GAL.)	0	7.5	15	
pH (S.U.)	9.10	9.15	9.09	
SP. COND. (µMHOS/CM)	720	728	732	
WATER TEMP. (°C)	17.6	17.6	17.0	
TURBIDITY*	3	3	3	3

*VISUAL DETERMINATION ONLY
(1) CLEAR (2) SLIGHT (3) MODERATE (4) HIGH



LAW ENVIRONMENTAL, INC.
NATIONAL LABORATORIES
7215 PINE FOREST ROAD
PENSACOLA, FLORIDA 32526
(904) 944-9772

CHAIN OF CUSTODY RECORD

SAMPLING
INFORMATION

NAME OF FACILITY: _____

STREET ADDRESS: _____

CITY/STATE: _____

ZIP: _____

PROJECT NAME

JOB NO.

Cherry Point Task Team #1

07174-01

SAMPLERS (SIGNATURE)

SAMPLING DATE

11/21/91

TIME

GRAB

COMP.

SOURCE
CODE

SAMPLE STATION DESCRIPTION

TOTAL
NO. OF CONTAINERS

CONTAINER TYPE

40 ml/100 VOA HQ

1 LG. P. (HNO₃)

1 LG. P. (NaOH)

1 LG. P. (H₂SO₄)

1 LG. P.

1 LG. P. (NaOH + Ascorbic Acid)

1 LG. P. (Zn Acetate + NaOH)

8 oz. G. P.

1 LG. P.

1 LG. P. (Opacure)

250 ml/G. Amber

3 L. L.L. P. (H₂O₂)

LENL LAB NO.

1008

✓

HP

HP-35

1

3

1

AA15570

0922

✓

HP

HP-45

4

3

1

AA15571

0816

✓

HP

HP-9D

1

3

1

AA15572

Top Blank

3

3

AA15573

RELINQUISHED BY:

(SIGNATURE)

DATE/TIME

11/21/91 1730

RECEIVED BY:

(SIGNATURE)

RELINQUISHED BY:

(SIGNATURE)

RECEIVED BY:

(SIGNATURE)

DATE/TIME

11/22/91

RELINQUISHED BY:

(SIGNATURE)

DATE/TIME

11/22/91

RECEIVED BY:

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RECEIVED BY:

(SIGNATURE)

DATE/TIME

11/22/91

1100

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PINK COPY RETAINED BY SAMPLERS. YELLOW COPY RETAINED BY LABORATORY.

REMARKS: Sludge V. 1.0000 Ex. 1000

* SOURCE
CODES:

RECOVERY WELL - RW
RCRA MONITORING WELL - MW
SOIL/SEDIMENT - SO
SLUDGE - SL
NPDES DISCHARGE - ND
DRINKING WATER - DW
HAZARDOUS WASTE - HW



LAW ENVIRONMENTAL, INC.
NATIONAL LABORATORIES
7215 PINE FOREST ROAD
PENSACOLA, FLORIDA 32526
(904) 944-9772

CHAIN OF CUSTODY RECORD

1955

SAMPLING INFORMATION

NAME OF FACILITY: _____

STREET ADDRESS: _____

CITY/STATE: _____

ZIP: _____

PROJECT NAME				JOB NO.	TOTAL NO. OF CONTAINERS	CONTAINER TYPE																LENL LAB NO.
SAMPLERS (SIGNATURE)						40 mL/G VOA HCl	1 L.G. P (HNO ₃)	1 L.G. P (NaOH)	1 L.G. P (H ₂ SO ₄)	1 L.G. P	1 L.P. (NaOH + Alcoholic Acid)	1 L.G. P (Zn Acetate + NaOH)	8 oz. G.P.	1 L.G. P	1 L.P. - Amber	250 mL/G - Amber	500 mL/G - Amber	1000 mL/G - Amber				
TIME	GRAB	COMP.	SOURCE CODE	SAMPLE STATION DESCRIPTION																		
				HP-25	4	3													AA15714			
1705	Y		HP	HP-25	4	3													AA15714			
1530	Y		HP	HP-5D	4	3													AA15715			
1545	Y		HP	HP-6D	5	4													AA15716			
1410	Y		HP	HP-7D	4	3													AA15717			
1205	Y		HP	HP-8D	5	4													AA15718			
1408	Y		HP	HP-10D	4	3													AA15719			
				Rinse BLANK	4	3													AA15720			
				TRIP BLANK	3	3													AA15721			

RELINQUISHED BY: <i>Jim O'Brien</i> (SIGNATURE)	DATE/TIME 11/24/80	RECEIVED BY: _____ (SIGNATURE)	RELINQUISHED BY: _____ (SIGNATURE)	RECEIVED BY: _____ (SIGNATURE)	DATE/TIME 1
RELINQUISHED BY: _____ (SIGNATURE)	DATE/TIME 1	RECEIVED BY: _____ (SIGNATURE)	RELINQUISHED BY: _____ (SIGNATURE)	RECEIVED AT LABORATORY <i>Q. Gacamas</i> (SIGNATURE)	DATE/TIME 12/9/11/85

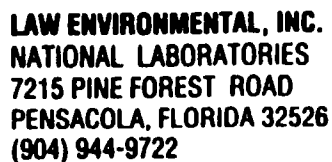
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PINK COPY RETAINED BY SAMPLERS. YELLOW COPY RETAINED BY LABORATORY

REMARKS: *Shipped via Fed Ex*

* SOURCE
CODES:

RECOVERY WELL - RW
RCRA MONITORING WELL - MW
SOIL/SEDIMENT - SO
SLUDGE - SL
NPDES DISCHARGE - ND
DRINKING WATER - DW
HAZARDOUS WASTE - HW



5202

SAMPLING INFORMATION
NPDES NUMBER _____

NAME OF FACILITY: Cherry Point
STREET ADDRESS: _____

[illegible]

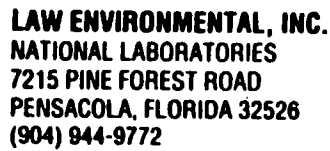
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REMARKS Invoice samples (8GW27-55 & 8GW27-56) to 475-07174-05.
Invoice samples (13GW26-55 & 13GW26-56) to 475-07174-09.

•SOURCE CODES

RECOVERY WELL - RW
RCRA MONITORING WELL - MW
SOIL / SEDIMENT - SO
SLUDGE - SL

NPDES DISCHARGE ND
DRINKING WATER DW
HAZARDOUS WASTE HW
SURFACE WATER SW
NON AQUEOUS NA



1761

NAME OF FACILITY: _____
STREET ADDRESS: _____
CITY/STATE: _____ **ZIP:** _____

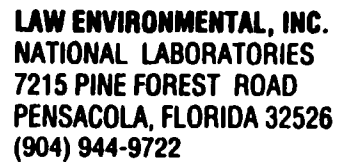
RECOVERY WELL - RW
RCRA MONITORING WELL - MW
SOIL/SEDIMENT - SO
SLUDGE - SL
NPDES DISCHARGE - ND
DRINKING WATER - DW
HAZARDOUS WASTE - HW

• SOURCE CODES:

DISTRIBUTION: ORIGINAL AND YELLOW COPIES ACCOMPANY SAMPLE SHIPMENT TO LABORATORY.

PINK COPY RETAINED BY SAMPLERS YELLOW COPY RETAINED BY LABORATORY

REMARKS: 136W29 Pb container is not preserved.



5295

NAME OF FACILITY: _____
STREET ADDRESS: _____

DISTRIBUTION: ORIGINAL AND YELLOW COPIES ACCOMPANY SAMPLE SHIPMENT TO LABORATORY. PINK COPY RETAINED BY SAMPLERS. YELLOW COPY RETAINED BY LABORATORY.

RECOVERY WELL - RW	NPDES DISCHARGE - ND
RCRA MONITORING WELL - MW	DRINKING WATER - DW
SOIL / SEDIMENT - SO	HAZARDOUS WASTE - HW
SLUDGE - SL	SURFACE WATER - SW
	NON-AQUEOUS - NA

APPENDIX G

MONITORING WELL SAMPLING LABORATORY ANALYTICAL TEST REPORTS

Law Environmental, Inc.
Pensacola Branch
7215 Pine Forest Road
Pensacola, Florida 32526



December 16, 1991

Mr. Chris Cornelissen
Law Engineering, Inc.
3301 Atlantic Avenue
Raleigh, NC 27604
Clt#12024 Proj#475-07174-05,04

Dear Mr. Cornelissen:

Below are results of analysis of 1 sample received for examination
on December 7, 1991:

Location code: CP7 Loc. Desc.: [REDACTED]
LAB I.D. AA15996 P.O./Project No.: 47507174 Client No.: 12024
Collection Date: 12/05/91
Submittal Date: 12/07/91 Submittal Time: 11:45
Sample collector: LISTED ON COC

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
-------------------	-------	----------------	--------------------

Multicomponent analysis: 2321-VOA W. by GC EPA 601

Bromodichloromethane	ug/L	Not Det	0.3
Bromoform	ug/L	Not Det	0.6
Bromomethane	ug/L	Not Det	5.0
Carbon tetrachloride	ug/L	Not Det	1.0
Chloroethane	ug/L	Not Det	5.0
2-Chloroethylvinyl ether	ug/L	Not Det	1.0
Chloroform	ug/L	Not Det	2.0
Chloromethane	ug/L	Not Det	5.0
Dibromochloromethane	ug/L	Not Det	0.9
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
1,1-Dichloroethane	ug/L	Not Det	0.6
1,2-Dichloroethane	ug/L	Not Det	1.0
1,1-Dichloroethene	ug/L	Not Det	0.9
trans-1,2-Dichloroethene	ug/L	Not Det	0.6
1,2-Dichloropropane	ug/L	Not Det	0.3
cis-1,3-Dichloropropene	ug/L	Not Det	0.6
trans-1,3-Dichloropropene	ug/L	Not Det	0.6
Methylene chloride	ug/L	Not Det	250.0
1,1,2,2-Tetrachloroethane	ug/L	Not Det	2.0
Tetrachloroethene	ug/L	Not Det	1.0
1,1,1-Trichloroethane	ug/L	Not Det	1.0

Mr. Chris Cornelissen
Page: 2
December 16, 1991

2321-VOA W. by GC EPA 601 (continued):

1,1,2-Trichloroethane	ug/L	Not Det	0.9
Trichloroethene	ug/L	Not Det	0.6
Trichlorofluoromethane	ug/L	Not Det	0.9
Vinyl chloride	ug/L	Not Det	5.0

Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	Not Det	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	Not Det	0.3
Toluene	ug/L	Not Det	0.5
Xylenes (total)	ug/L	Not Det	1.0
		1	1.0

Multicomponent analysis: 2322-Prior. Poll. Semi-VOA. W.

Acenaphthene	ug/L	.5	0.5
Acenaphthylene	ug/L	Not Det	0.5
Anthracene	ug/L	Not Det	0.5
Benz[a]anthracene	ug/L	Not Det	0.3
Benzidine	ug/L	Not Det	5.0
3,4-Benzofluoranthene	ug/L	Not Det	1.0
Benzo[k]fluoranthene	ug/L	Not Det	1.0
Benzo[ghi]perylene	ug/L	Not Det	1.0
Benzo[a]pyrene	ug/L	Not Det	0.7
bis(2-Chloroethoxy)methane	ug/L	Not Det	0.6
bis(2-Chloroethyl)ether	ug/L	Not Det	0.6
bis(2-Chloroisopropyl)ether	ug/L	Not Det	0.5
bis(2-Ethylhexyl)phthalate	ug/L	Not Det	5.0
4-Bromophenyl phenyl ether	ug/L	Not Det	0.6
Butylbenzyl phthalate	ug/L	Not Det	1.0
2-Chloronaphthalene	ug/L	Not Det	0.6
4-Chlorophenyl phenyl ether	ug/L	Not Det	0.6
Chrysene	ug/L	Not Det	0.5
Dibenz[a,h]anthracene	ug/L	Not Det	1.0
Di-n-butyl phthalate	ug/L	Not Det	5.0
1,2-Dichlorobenzene	ug/L	Not Det	0.5
1,3-Dichlorobenzene	ug/L	Not Det	0.7
1,4-Dichlorobenzene	ug/L	Not Det	0.6
3,3'-Dichlorobenzidine	ug/L	Not Det	2.0
Diethyl phthalate	ug/L	Not Det	1.0
Dimethyl phthalate	ug/L	Not Det	1.0
2,4-Dinitrotoluene	ug/L	Not Det	0.5
2,6-Dinitrotoluene	ug/L	Not Det	0.7
Di-n-octylphthalate	ug/L	Not Det	5.0
1,2-Diphenylhydrazine	ug/L	Not Det	0.5
Fluoranthene	ug/L	Not Det	0.8

Mr. Chris Cornelissen

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December 16, 1991

2322-Prior. Poll. Semi-VOA. W. (continued):

Fluorene	ug/L	Not Det	0.7
Hexachlorobenzene	ug/L	Not Det	0.6
Hexachlorobutadiene	ug/L	Not Det	0.6
Hexachlorocyclopentadiene	ug/L	Not Det	1.0
Hexachloroethane	ug/L	Not Det	0.7
Indeno[1,2,3-cd]pyrene	ug/L	Not Det	1.0
Isophorone	ug/L	Not Det	0.7
Naphthalene	ug/L	Not Det	0.3
Nitrobenzene	ug/L	Not Det	1.0
N-Nitrosodimethylamine	ug/L	Not Det	5.0
N-Nitrosodiphenylamine (as DPA)	ug/L	Not Det	0.5
N-Nitrosodi-n-propylamine	ug/L	Not Det	0.6
Phenanthrene	ug/L	.5	0.4
Pyrene	ug/L	Not Det	0.3
1,2,4-Trichlorobenzene	ug/L	Not Det	0.7

2323-Cont Liq Liq Ext. EPA 3520

done

Multicomponent analysis: 2310-Fur. Metals W. EPA 7000

Lead	ug/L	Not Det	2.0
2310-Furnace Dig W. EPA 3020		done	

Please advise should you have questions concerning these data.

Respectfully submitted,

D. Allett for
James M.G. Tucci, Laboratory Manager

Attn: Sample Receiving

(Dept or Name)

Date results requested: 12/13/91

[illegible]

Mr. Chris Cornelissen

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Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	Not Det	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	Not Det	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	Not Det	1.0

2310-Furnace Dig W. EPA 3020

done

Multicomponent analysis: 2310-Fur. Metals W. EPA 7000

Lead	ug/L	380	2.0
------	------	-----	-----

Location code: POINT Loc. Desc.: Trip Blank
LAB I.D. AA15378 P.O./Project No.: 47507174 Client No.: 12024
Collection Date: 11/19/91
Submittal Date: 11/21/91 Submittal Time: 14:47
Sample collector: CORNELISSEN

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
-------------------	-------	----------------	--------------------

Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	Not Det	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	Not Det	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	2	1.0

Location code: POINT Loc. Desc.: Potable Water
LAB I.D. AA15379 P.O./Project No.: 47507174 Client No.: 12024
Collection Date: 11/19/91 Collection Time: 10:25
Submittal Date: 11/21/91 Submittal Time: 14:47
Sample collector: CORNELISSEN

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Mr. Chris Cornelissen
Page: 3
December 10, 1991

Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	Not Det	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	Not Det	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	Not Det	1.0
2310-Furnace Dig W. EPA 3020		done	

Multicomponent analysis: 2310-Fur. Metals W. EPA 7000

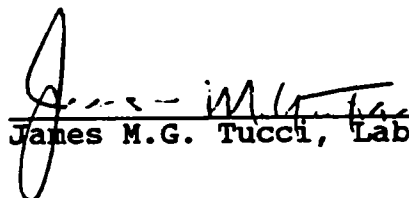
Lead	ug/L	Not Det	2.0
2323-BN Liq. Liq. Ext. EPA 3520		done	

Multicomponent analysis: 2321-Poly Aro Hydro W. EPA 610

Acenaphthene	ug/L	Not Det	1.0
Acenaphthylene	ug/L	Not Det	1.0
Anthracene	ug/L	Not Det	1.0
Benzo[a]anthracene	ug/L	Not Det	1.0
Benzo[b]fluoranthene	ug/L	Not Det	1.0
Benzo[k]fluoranthene	ug/L	Not Det	1.0
Benzo[ghi]perylene	ug/L	Not Det	1.0
Benzo[a]pyrene	ug/L	Not Det	1.0
Chrysene	ug/L	Not Det	1.0
Dibenzo[a,h]anthracene	ug/L	Not Det	1.0
Fluoranthene	ug/L	Not Det	1.0
Fluorene	ug/L	Not Det	1.0
Indeno[1,2,3-cd]pyrene	ug/L	Not Det	1.0
1-Methylnaphthalene	ug/L	Not Det	1.0
2-Methylnaphthalene	ug/L	Not Det	1.0
Naphthalene	ug/L	Not Det	1.0
Phenanthrene	ug/L	Not Det	1.0
Pyrene	ug/L	Not Det	1.0

Please advise should you have questions concerning these data.

Respectfully submitted,


James M.G. Tucci, Laboratory Manager

Law Environmental, Inc.
Pensacola Branch
7215 Pine Forest Road
Pensacola, Florida 32526



January 13, 1992

Mr. Chris Corneliseen
Law Engineering, Inc.
3301 Atlantic Avenue
Raleigh, NC 27604
Clt. #12024 Proj. #475-07174-04

Dear Mr. Corneliseen:

Below are results of analysis of 9 samples received for examination
on December 21, 1991:

Location code: CP13 Loc. Desc.: 13GW26
LAB I.D. AA16377 P.O./Project No.: 0717404 Client No.: 12024
Collection Date: 12/19/91
Submittal Date: 12/21/91 Submittal Time: 11:52
Sample collector: PROCTOR

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	38	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	33	0.5
Toluene	ug/L	9	1.0
Xylenes (total)	ug/L	110	1.0

Multicomponent analysis: 2310-Fur. Metals W. EPA 7000

Lead	ug/L	100	2.0
2310-Furnace Dig W. EPA 3020		done	

Location code: CP13 Loc. Desc.: 13GW27
LAB I.D. AA16378 P.O./Project No.: 0717404 Client No.: 12024
Collection Date: 12/19/91
Submittal Date: 12/21/91 Submittal Time: 11:52
Sample collector: PROCTOR

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Mr. Chris Corneliseen
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Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	8	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	.9	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	3	1.0

Multicomponent analysis: 2310-Fur. Metals W. EPA 7000

Lead	ug/L	140	2.0
2310-Furnace Dig W. EPA 3020		done	

Location code: CP13 Loc. Desc.: 13GW29
LAB I.D. AA16379 P.O./Project No.: 0717404 Client No.: 12024
Collection Date: 12/19/91
Submittal Date: 12/21/91 Submittal Time: 11:52
Sample collector: PROCTOR

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	560	20.0
Chlorobenzene	ug/L	Not Det	30.0
1,2-Dichlorobenzene	ug/L	Not Det	30.0
1,3-Dichlorobenzene	ug/L	Not Det	30.0
1,4-Dichlorobenzene	ug/L	Not Det	30.0
Ethylbenzene	ug/L	Not Det	50.0
Toluene	ug/L	Not Det	100.0
Xylenes (total)	ug/L	140	100.0

Multicomponent analysis: 2310-Fur. Metals W. EPA 7000

Lead	ug/L	Not Det	2.0
2310-Furnace Dig W. EPA 3020		done	

Mr. Chris Corneliseen
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Location code: CP13 Loc. Desc.: 13GWRB
LAB I.D. AA16380 P.O./Project No.: 0717404 Client No.: 12024
Collection Date: 12/19/91
Submittal Date: 12/21/91 Submittal Time: 11:52
Sample collector: PROCTOR

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	Not Det	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	Not Det	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	Not Det	1.0

Location code: CP13 Loc. Desc.: TRAVEL BLANK
LAB I.D. AA16381 P.O./Project No.: 0717404 Client No.: 12024
Collection Date: 12/19/91
Submittal Date: 12/21/91 Submittal Time: 11:52
Sample collector: PROCTOR

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	Not Det	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	Not Det	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	Not Det	1.0

Mr. Chris Corneliseen
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January 13, 1992

Location code: CP13 Loc. Desc.: 8GWRB
LAB I.D. AA16384 P.O./Project No.: 0717405 Client No.: 12024
Collection Date: 12/19/91
Submittal Date: 12/21/91 Submittal Time: 11:52
Sample collector: PROCTOR

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	33	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	Not Det	0.5
Toluene	ug/L	1	1.0
Xylenes (total)	ug/L	1	1.0

Location code: CP13 Loc. Desc.: 13GW28
LAB I.D. AA16459 P.O./Project No.: 0717404 Client No.: 12024
Collection Date: 12/19/91
Submittal Date: 12/21/91 Submittal Time: 16:28
Sample collector: PROCTOR

TEST PARAMETER	UNITS	TEST RESULT	DETECTION LIMIT
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Multicomponent analysis: 2321-VOA W. by GC EPA 602

Benzene	ug/L	7	0.2
Chlorobenzene	ug/L	Not Det	0.3
1,2-Dichlorobenzene	ug/L	Not Det	0.3
1,3-Dichlorobenzene	ug/L	Not Det	0.3
1,4-Dichlorobenzene	ug/L	Not Det	0.3
Ethylbenzene	ug/L	.6	0.5
Toluene	ug/L	Not Det	1.0
Xylenes (total)	ug/L	Not Det	1.0

Multicomponent analysis: 2310-Fur. Metals W. EPA 7000

Lead	ug/L	Not Det	2.0
2310-Furnace Dig W. EPA 3020		done	

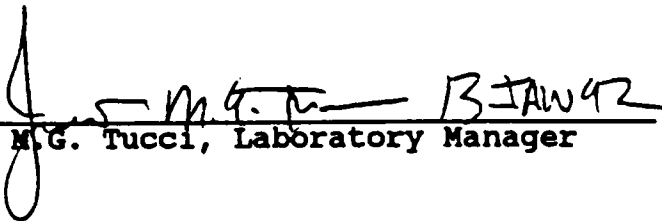
Mr. Chris Corneliseen

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January 13, 1992

Please advise should you have questions concerning these data.

Respectfully submitted,


James M.G. Tucci, Laboratory Manager

APPENDIX H

AQUIFER PARAMETER DETERMINATIONS



LAW ENGINEERING

GEOTECHNICAL, ENVIRONMENTAL
& CONSTRUCTION MATERIALS
CONSULTANTS

3301 ATLANTIC AVE.
P.O. BOX 18288
RALEIGH, NC 27619
919-876-0416

JOB NO. 07174-04 SHEET 1 OF 5
JOB NAME CHERRY POINT MCAS
SUBJECT Pump Test Calculations
BY CJA DATE 1/10/92
CHECKED BY ZAP DATE 1/21/92

TANK FARM A, 13GW30 & 13GW31

1. DISTANCE - DRAWDOWN METHOD TO CALCULATE
AQUIFER PARAMETERS

Test Performed 12/17/91, 930 AM

$$Q = 15 \text{ gpm}$$

$$t = 0.3 \text{ days}$$

$$\Delta h (\text{one log cycle}) = 3.0 \text{ ft}$$

$$r_0 = 160 \text{ ft}$$

$$\text{TRANSMISSIVITY, } T = \frac{528Q}{\Delta h}$$

$$T = \frac{528(15)}{3.0} = 2640 \frac{\text{gpd}}{\text{ft}}$$

$$\text{Specific Storage, } S = \frac{0.3 T t}{r_0^2}$$

$$S = \frac{(0.3)(2640)(0.3)}{(160)^2} = 0.009$$

Reference: Driscoll, Groundwater and Wells, 1986, pp 236-7.



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919-876-0416

JOB NO. 07174-04 SHEET 2 OF 5
JOB NAME CHERRY POINT MCAS
SUBJECT PUMP TEST CALCULATIONS
BY CJA DATE 1/10/92
CHECKED BY ZAP DATE 1/21/92

TANK FARM A, 13GW31

2. TIME VS DRAWDOWN METHOD TO CALCULATE

AQUIFER PARAMETERS

Test Performed 12/17/91, 930am

$$Q = 15 \text{ gpm}$$

$$r = 84 \text{ ft}$$

$$\Delta h (\text{one cycle}) = 0.47 \text{ ft}$$

$$t_0 = 1.6 \times 10^{-3} \text{ days}$$

$$\text{Transmissivity, } T = \frac{264Q}{\Delta h}$$

$$T = \frac{264(15)}{0.47} = 8425 \text{ gpd/ft}$$

$$\text{Specific Storage, } S = \frac{0.3 T t_0}{r^2}$$

$$S = \frac{0.3 (8425) (1.6 \times 10^{-3})}{(84)^2} = 0.00057$$

Reference: Driscoll, Groundwater and Wells, 1986, pp 221-2.



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JOB NO. 07174-04 SHEET 3 OF 5
JOB NAME CHERRY POINT MC45
SUBJECT PUMP TEST Calculations
BY CJA DATE 1/10/92
CHECKED BY 7/11 DATE 1/21/92

TANK FARM A, 13GW30

3. TIME VS DRAWDOWN METHOD TO CALCULATE AQUIFER PARAMETERS

Test Performed 12/17/91, 930am

$$Q = 15 \text{ gpm}$$

$$r = 38 \text{ ft}$$

$$\Delta h (\text{one cycle}) = 1.21 \text{ ft}$$

$$t_0 = 1.3 \times 10^{-3} \text{ days}$$

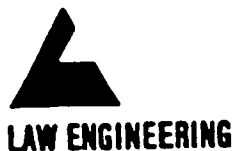
$$\text{TRANSMISSIVITY, } T = \frac{264 Q}{\Delta h}$$

$$T = \frac{264 (15)}{1.21} = 3273 \text{ gpd/ft}$$

$$\text{Specific Storage, } S = \frac{0.3 T t_0}{r^2}$$

$$S = \frac{0.3 (3273) (1.3 \times 10^{-3})}{(38)^2} = 0.00088$$

Reference: Driscoll, Groundwater and Wells, 1986, pp 221-2



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JOB NO. 07174-04 SHEET 4 OF 5
JOB NAME CHERRY POINT MCAS
SUBJECT Pump Test Calculations
BY CJA DATE 1/10/92
CHECKED BY 1/21/92 DATE 7/10

TANK FARM A, 13GW30

4. TYPE CURVE MATCHING METHOD TO DETERMINE
AQUIFER PARAMETERS

Test Performed 12/17/91, 930am

$$Q = 15 \text{ gpm}$$

Match Point Values:

$$(h_o - h)_m = 0.68 \text{ ft}$$

$$(r^2/t)_m = 1.2 \times 10^6$$

$$(u)_m = 1, W(u)_m = 1$$

$$\text{Transmissivity, } T = \frac{114.6 Q W(u)_m}{(h_o - h)_m}$$

$$T = \frac{114.6 (15) (1)}{(0.68)} = 2528 \text{ gpd/ft}$$

$$\text{Specific Storage, } S = \frac{u_m T}{4.87 (r^2/t)_m}$$

$$S = \frac{(1)(2528)}{(1.87)(1.2 \times 10^6)} = 0.001$$

References: FREEZE and CHERRY, 1979, pp 344-346
Driscoll, 1986, p. 260



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JOB NO. 07174-04 SHEET 5 of 5
JOB NAME CHERRY POINT MCAS
SUBJECT Pumping Test Calculations
BY CJA DATE 1/10/91
CHECKED BY 7AP DATE 1/21/92

TANK FARM A, 13GW31

5. TYPE CURVE MATCHING METHOD TO DETERMINE AQUIFER PARAMETERS

Test Performed 12/17/91, 930am

$$Q = 15 \text{ gpm}$$

Match Point Values: $(h_0 - h)_m = 0.24 \text{ ft}$

$$(r^2/t)_m = 5 \times 10^6$$

$$(u)_m = 1, W(u_m) = 1$$

$$\text{Transmissivity, } T = \frac{114.6 Q}{(h_0 - h)_m} W(u_m)$$

$$T = \frac{114.6 (15)(1)}{0.24} = 7163 \text{ gpd/ft}$$

$$\text{Specific Storage, } S = \frac{u_m T}{1.87 (r^2/t)_m}$$

$$S = \frac{(1)(7163)}{(1.87)(5 \times 10^6)} = 0.0008$$

References: FREEZE and CHERRY, 1979, pp 344-346.

Driscoll, 1986, p. 260

PUMP TEST FORM

COPY

COMPANY: 03174-04OBS. WELL NO.: 136W30JOB: MEAS - Tank Farm "A"DESCRIPTION OF MEASURING POINT: Top of CasingJOB LOCATION: Cherry Pt., N.C.DISTANCE FROM PUMPED WELL: 38'ENGINEER: T. PROCTORDATE: 12/17/91STATIC WATER LEVEL AT 930 AM PH 8.25Checked (JA)
1/10/92

Time of measurement	Time Since Pumping (Began) Stopped Minutes	T (days)	Tape Wet at, ft	Depth to Water ft	Drawdown ft	r^2/T (days) Remarks	T/r^2
940	0	0		8.25	0	0	0
940 1/2	0.5	3.47×10^{-4}		8.33	0.08	4.2×10^6	
941	1	6.94×10^{-4}		8.38	0.13	2.1×10^6	
942	2	1.39×10^{-3}		8.46	0.21	1.0×10^6	
943	3	2.08×10^{-3}		8.58	0.33	6.9×10^5	
944	4	2.78×10^{-3}		8.67	0.42	5.2×10^5	
945	5	3.47×10^{-3}		8.79	0.54	4.2×10^5	
948	8	5.55×10^{-3}		9.08	0.83	2.4×10^5	
950	10	6.94×10^{-3}		9.17	0.92	2.1×10^5	
955	15	1.09×10^{-2}		9.38	1.13	1.4×10^5	
1000	20	1.39×10^{-2}		9.50	1.25	1.0×10^5	
1010	30	2.08×10^{-2}		9.71	1.46	6.9×10^4	
1020	40	2.78×10^{-2}		9.81	1.56	5.2×10^4	
1036	56	3.89×10^{-2}		9.85	1.60	3.7×10^4	
1050	70	4.86×10^{-2}		9.85	1.60	3.0×10^4	
1100	80	5.56×10^{-2}		9.88	1.63	2.6×10^4	
1120	100	6.94×10^{-2}		9.90	1.65	2.1×10^4	
1140	120	8.33×10^{-2}		9.92	1.67	1.7×10^4	

PUMP TEST FORM

COMPANY: 07174-04

OBS. WELL NO.: 136430

DB: MCAS- Tank Farm "A"

DESCRIPTION OF MEASURING POINT: Top of Casing

JOB LOCATION: Cherry Pt., N.C

DISTANCE FROM
PUMPED WELL: 38'

ENGINEER: T. PROCTOR

STATIC WATER LEVEL
AT 930 AM 8.25 PM

ATE: 12/17/91

STATIC WATER LEVEL
AT 930 AM 8.25 PM

Checked CJA, 1/10, 92

[illegible]

PUMP TEST FORM

COMPANY: 07174-04OBS. WELL NO.: 136W31JOB: MCAS Tank Farm "A"DESCRIPTION OF MEASURING POINT: Top of CasingJOB LOCATION: Cherry Pt., N.C.DISTANCE FROM PUMPED WELL: 84' (24') = 7056ENGINEER: A. WoodyDATE: 12/17/91STATIC WATER LEVEL AT 930 AM 7.84 PM

Checked, CJA 1/10/92

Time of measurement	Time Since Pumping Began Stopped Minutes	T (days) Tape Held at, ft	Tape Wet at, ft	Depth to Water ft	Drawdown ft	$\frac{r^2}{C}$ (day) Remarks
940	0			7.84	0	
941	1	6.944×10^{-4}		7.85	0.01	1.0×10^7
942	2	1.39×10^{-3}		7.89	0.05	5.1×10^6
943	3	2.08×10^{-3}		7.95	0.11	3.4×10^6
944	4	2.78×10^{-3}		7.96	0.12	2.5×10^6
945	5	3.47×10^{-3}		8.00	0.16	2.0×10^6
946	6	4.24×10^{-3}		8.05	0.21	1.7×10^6
947	7	4.9×10^{-3}		8.11	0.27	1.4×10^6
953	13	9.0×10^{-3}		8.20	0.36	7.5×10^5 7.8×10^5 cya
955	15	1.04×10^{-2}		8.22	0.38	6.8×10^5
1005	25	1.7×10^{-2}		8.32	0.48	4.1×10^5
1015	35	2.4×10^{-2}		8.39	0.55	2.9×10^5
1025	45	3.1×10^{-2}		8.44	0.60	2.3×10^5
1035	55	3.8×10^{-2}		8.44	0.60	1.8×10^5
1045	65	4.5×10^{-2}		8.46	0.62	1.6×10^5
1055	75	5.2×10^{-2}		8.48	0.64	1.4×10^5
1105	85	5.9×10^{-2}		8.50	0.66	1.2×10^5
1125	105	7.3×10^{-2}		8.52	0.68	9.7×10^4

COMPANY: 07174-04

OBS. WELL NO.: 136431

108: MCAS - Tank Farm "A"

DESCRIPTION OF MEASURING POINT: Top of casing

JOB LOCATION: Cherry Pt., N.C.

DISTANCE FROM
PUMPED WELL: 84' $r^2 = 7056$

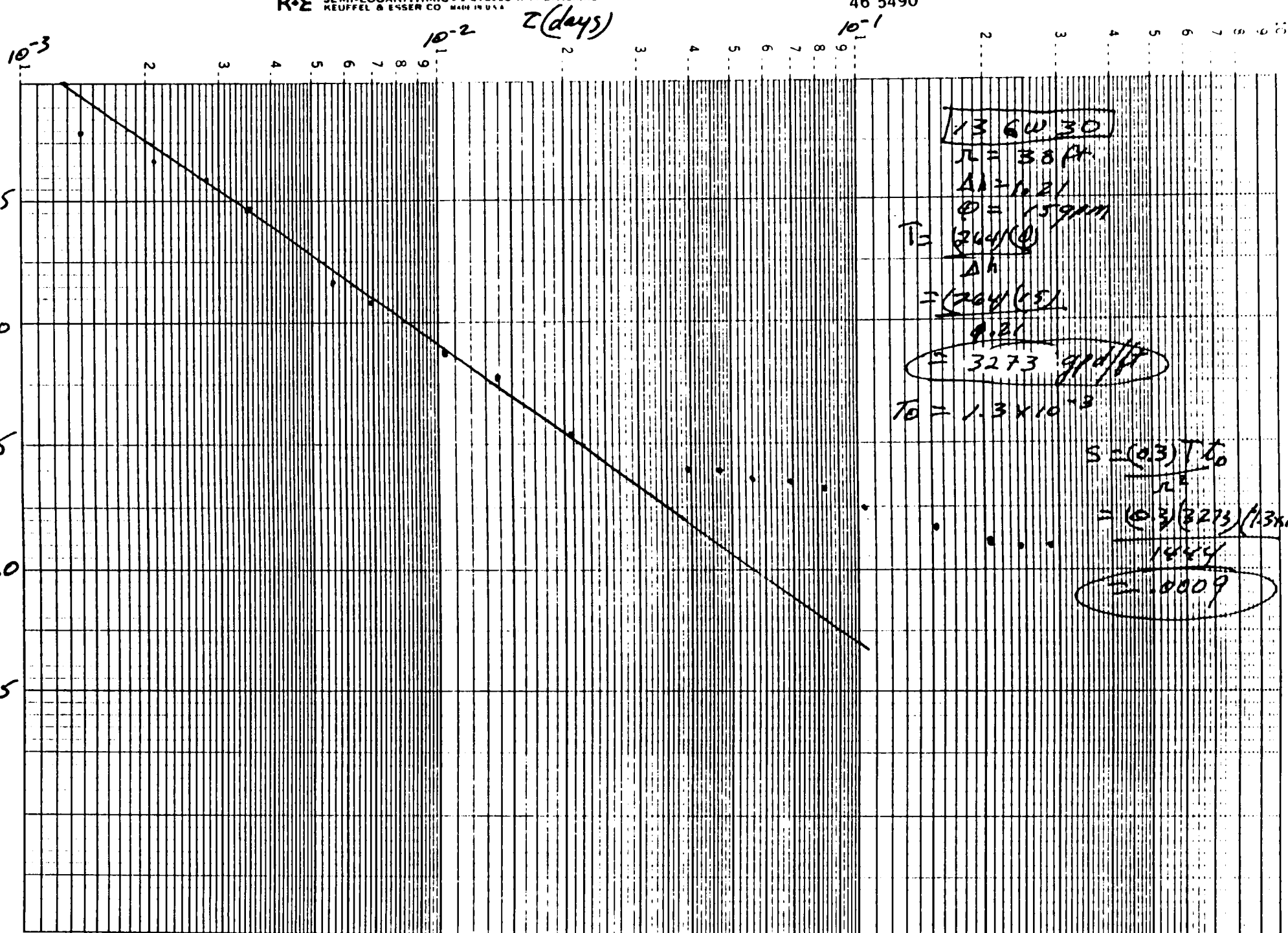
ENGINEER: A. Woody

STATIC WATER LEVEL
AT 930 AM 7.84 PM

DATE: 12/17/91

Checked, CIA 1/10/92

[illegible]



13 64 30

$\pi = 3.8 \text{ ft}$

$\Delta h = 10.21$

$\phi = 159 \text{ ft}$

$T = \frac{(204)(\phi)}{\Delta h}$

$= \frac{(204)(159)}{10.21}$

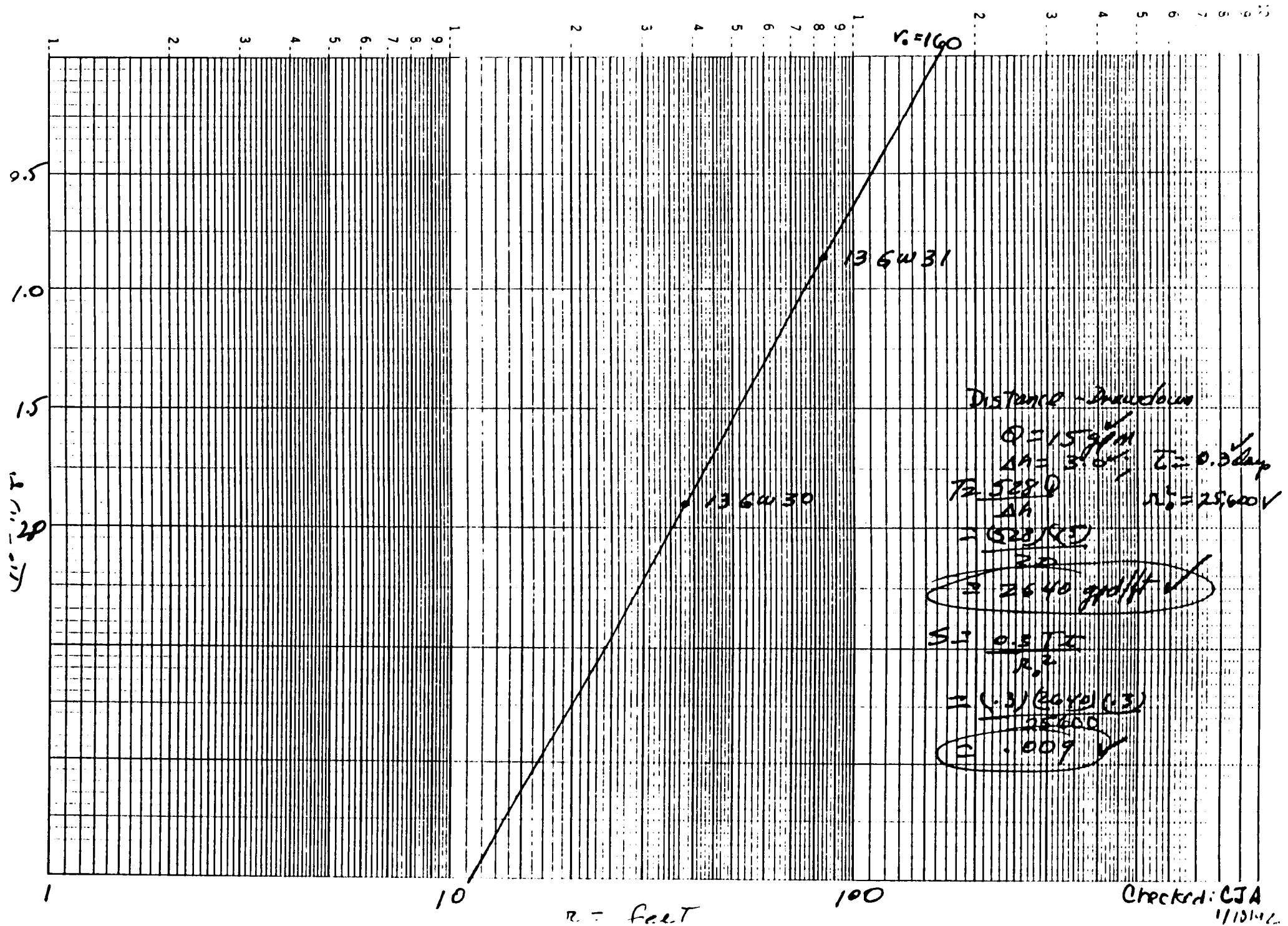
$= 3273 \text{ gpd/ft}$

$T_0 = 1.3 \times 10^{-3}$

$S = \frac{(0.3) T_0}{\pi^2}$

$= \frac{(0.3)(3273)(1.3 \times 10^{-3})}{10.21^2}$

$= 0.0009$





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919-876-0416

JOB NO. 07174-04 SHEET 1 OF 8

JOB NAME CHERRY POINT

SUBJECT Hydrogeologic Data

BY CJA DATE 1/8/92

CHECKED BY ZN DATE 1/22/92

TANK FARM A, 13GW28, S-5

KRUMBEIN'S ϕ UNITS

$$\phi = -\log_2 d$$

FROM GRAIN SIZE DISTRIBUTION
TEST REPORT:

$$d_{16} = 0.155$$

$$d_{84} = 0.41$$

$$d_5 = 0.07$$

$$d_{95} = 0.64$$

$$d_{50} = 0.225$$

(a) d_{16}

$$\phi = -\log_2(0.155)$$

$$= \frac{-\ln(0.155)}{\ln 2}$$

$$= 2.690$$

$$\text{THEN } [d_{16} = 2.690 \phi]$$

b) d_{84}

$$\phi = -\log_2(0.41)$$

$$= \frac{-\ln(0.41)}{\ln 2}$$

$$[d_{84} = 1.29 \phi]$$

(c) d_5

$$\phi = -\log_2(0.07)$$

$$= \frac{-\ln(0.07)}{\ln 2}$$

$$[d_5 = 3.84 \phi]$$

(d) d_{95}

$$\phi = -\log_2(0.64)$$

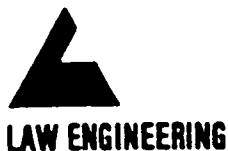
$$= \frac{-\ln(0.64)}{\ln 2}$$

$$[d_{95} = 0.64 \phi]$$

(e) $d_{50} = -\log_2(0.225)$

$$= \frac{-\ln(0.225)}{\ln 2}$$

$$[d_{50} = 2.152 \phi]$$



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JOB NO. 07174-04 SHEET 2 OF 8
JOB NAME CHERRY POINT
SUBJECT Hydrogeologic Data
BY CSA DATE 1/3/92
CHECKED BY ZP DATE 1/22/92

TANKFARM A, 13GW28, S-5 (CONTINUED)

INCLUSIVE STANDARD DEVIATION (SIZE SORTING)

$$\sigma_1 = \frac{d_{16} - d_{84}}{4} + \frac{d_5 - d_{95}}{6.6} = \frac{2.690 - 1.29}{4} + \frac{3.84 - 0.64}{6.6}$$

$$\sigma_1 = 0.35 + 0.485 = 0.83$$

HYDRAULIC CONDUCTIVITY (K) determined from
MASCH and DENNY, 1966.

$$K = 0.56 \text{ cm/min}$$

$$\text{or } K = \left(0.56 \frac{\text{cm}}{\text{min}}\right) \left(0.03281 \frac{\text{ft}}{\text{cm}}\right) \left(1440 \frac{\text{min}}{\text{day}}\right) = 26.4 \frac{\text{ft}}{\text{day}}$$

REFERENCE : FREEZE and CHERRY, 1979, pp 350-351



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JOB NO. 07174-04 SHEET 3 OF 8
JOB NAME CHERRY POINT
SUBJECT Hydrogeologic Data
BY CJA DATE 1/8/92
CHECKED BY ZAP DATE 1/24/92

TANK FARM A, 13GW28, S-6

KRUMBEIN'S ϕ UNITS

$$\phi = -\log_2 d$$

FROM GRAIN SIZE DISTRIBUTION
TEST REPORT:

$$d_{16} = 0.175$$

$$d_{84} = 0.41$$

$$d_5 = 0.13$$

$$d_{95} = 0.72$$

$$d_{50} = 0.28$$

(a) d_{16}

$$\begin{aligned}\phi &= -\log_2(0.175) \\ &= \frac{-\ln(0.175)}{\ln 2}\end{aligned}$$

$$= 2.514$$

$$\text{THEN } \boxed{d_{16} = 2.51\phi}$$

(b) d_{84}

$$\begin{aligned}\phi &= -\log_2(0.41) \\ &= \frac{-\ln(0.41)}{\ln 2}\end{aligned}$$

$$\boxed{d_{84} = 1.29\phi}$$

(c) d_5

$$\begin{aligned}\phi &= -\log_2(0.13) \\ &= \frac{-\ln(0.13)}{\ln 2}\end{aligned}$$

$$\boxed{d_5 = 2.94\phi}$$

(d) d_{95}

$$\begin{aligned}\phi &= -\log_2(0.72) \\ &= \frac{-\ln(0.72)}{\ln 2}\end{aligned}$$

$$\boxed{d_{95} = 0.47\phi}$$

(e) d_{50}

$$\begin{aligned}\phi &= -\log_2(0.28) \\ &= \frac{-\ln(0.28)}{\ln 2}\end{aligned}$$

$$\boxed{d_{50} = 1.84\phi}$$



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JOB NO. 07174-04 SHEET 4 OF 8
JOB NAME CHERRY POINT
SUBJECT Hydrogeologic Data
BY CJA DATE 1/9/92
CHECKED BY 1/22/92 DATE 2P

TANK FARM "A", 13GW28, S-6 (CONTINUED)

INCLUSIVE STANDARD DEVIATION (SIZE SORTING)

$$\sigma_i = \frac{d_{16} - d_{84}}{4} + \frac{d_5 - d_{95}}{6.6} = \frac{2.514 - 1.29}{4} + \frac{2.94 - 0.47}{6.6}$$

$$\sigma_i = 0.31 + 0.37 = 0.68$$

HYDRAULIC CONDUCTIVITY (K) DETERMINED FROM MASCH & DENNY, 1966

$$K = 0.71 \text{ cm/min}$$

$$\text{or } K = (0.71 \frac{\text{cm}}{\text{min}}) (0.03281 \frac{\text{ft}}{\text{cm}}) (1440 \frac{\text{min}}{\text{day}}) = 33.5 \frac{\text{ft}}{\text{day}}$$

REFERENCE : FREEZE and CHERRY, 1979, pp 350-351



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JOB NO. 07174-04 SHEET 5 OF 8

JOB NAME CHERRY POINT

SUBJECT Hydrogeologic Data

BY CJA DATE 1/9/92

CHECKED BY ZAP DATE 1/24/92

TANK FARM A, 13GW29, S-4

KRUMBEIN'S ϕ UNITS

$$\phi = -\log_2 d$$

FROM GRAIN SIZE DISTRIBUTION
TEST REPORT:

$$d_{16} = 0.013$$

$$d_{84} = 0.22$$

$$d_5 \approx 0.0005$$

$$d_{95} = 0.29$$

$$d_{50} = 0.13$$

(a) d_{16}

$$\phi = -\log_2 (0.013)$$

$$= \frac{-\ln(0.013)}{\ln 2} = 6.265$$

THEN

$$\boxed{d_{16} = 6.265 \phi}$$

(b) d_{84}

$$\phi = -\log_2 (0.22)$$

$$= \frac{-\ln(0.22)}{\ln 2}$$

$$\boxed{d_{84} = 2.18 \phi}$$

(c) d_5

$$\phi = -\log_2 (0.0005)$$

$$= \frac{-\ln(0.0005)}{\ln 2}$$

$$\boxed{d_5 = 10.966 \phi}$$

(d) d_{95}

$$\phi = -\log_2 (0.29)$$

$$= \frac{-\ln(0.29)}{\ln 2}$$

$$\boxed{d_{95} = 1.79 \phi}$$

(e) d_{50}

$$\phi = -\log_2 (0.13)$$

$$= \frac{-\ln(0.13)}{\ln 2}$$

$$\boxed{d_{50} = 2.94 \phi}$$



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JOB NO. 07174-04 SHEET 6 OF 8

JOB NAME CHERRY POINT

SUBJECT Hydrogeologic Data

BY CSA DATE 1/9/92

CHECKED BY ZAP DATE 1/22/92

TANK FARM A, 136W29, S-4 (CONTINUED)

INCLUSIVE STANDARD DEVIATION (SIZE SORTING)

$$\sigma_1 = \frac{d_{16} - d_{84}}{4} + \frac{d_5 - d_{95}}{6.6} = \frac{6.265 - 2.18}{4} + \frac{10.966 - 1.79}{6.6}$$

$$\sigma_1 = 1.02 + 1.39 = 2.41$$

ALTERNATE: IF d_5 assumed equal to $d_{10} = 0.0014\text{mm}$, then

$$d_5 = 9.480\phi \text{ and } \sigma_1 = 1.16 + 1.02 = 2.18$$

DISREGARD FOR NOW — THIS METHOD MAY NOT BE
APPLICABLE TO THIS MIX OF SOIL TYPES



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JOB NO. D7174-04 SHEET 7 OF 8

JOB NAME CHERRY POINT

SUBJECT Hydrogeologic Data

BY CJA DATE 1/9/91

CHECKED BY 7M DATE 1/22/92

TANK FARM A, 13GW29, S-5

KRUMBEIN'S ϕ UNITS

$$\phi = -\log_2 d$$

FROM GRAIN SIZE DISTRIBUTION
TEST REPORT:

$$d_{16} = 0.087$$

$$d_{84} = 0.25$$

$$d_5 = 0.0013$$

$$d_{95} = 0.38$$

$$d_{50} = 0.18$$

(a) d_{16}

$$\phi = -\log_2 (0.087)$$

$$= -\frac{\ln (0.087)}{\ln 2} = 3.523$$

THEN $d_{16} = 3.523 \phi$

(b) d_{84}

$$\phi = -\log_2 (0.25)$$

$$= -\frac{\ln (0.25)}{\ln 2}$$

$$d_{84} = 2.00 \phi$$

(c) d_5

$$\phi = -\log_2 (0.0013)$$

$$= -\frac{\ln (0.0013)}{\ln 2}$$

$$d_5 = 9.59 \phi$$

(d) d_{95}

$$\phi = -\log_2 (0.38)$$

$$= -\frac{\ln (0.38)}{\ln 2}$$

$$d_{95} = 1.396 \phi$$

(e) $d_{50} = -\log_2 (0.18)$

$$= -\frac{\ln (0.18)}{\ln 2}$$

$$d_{50} = 2.47 \phi$$



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JOB NO. 07174-04 SHEET 8 OF 8
JOB NAME CHERRY POINT
SUBJECT Hydrogeologic Data
BY CJA DATE 1/9/92
CHECKED BY JAP DATE 1/22/92

TANK FARM A, 13GW29, S-5 (CONTINUED)

INCLUSIVE STANDARD DEVIATION (SIZE SORTING)

$$\sigma_i = \frac{d_{16} - d_{84}}{4} + \frac{d_5 - d_{95}}{6.6} = \frac{3.523 - 2.00}{4} + \frac{9.59 - 1.396}{6.6}$$

$$\sigma_i = 0.38 + 1.24 = 1.62$$

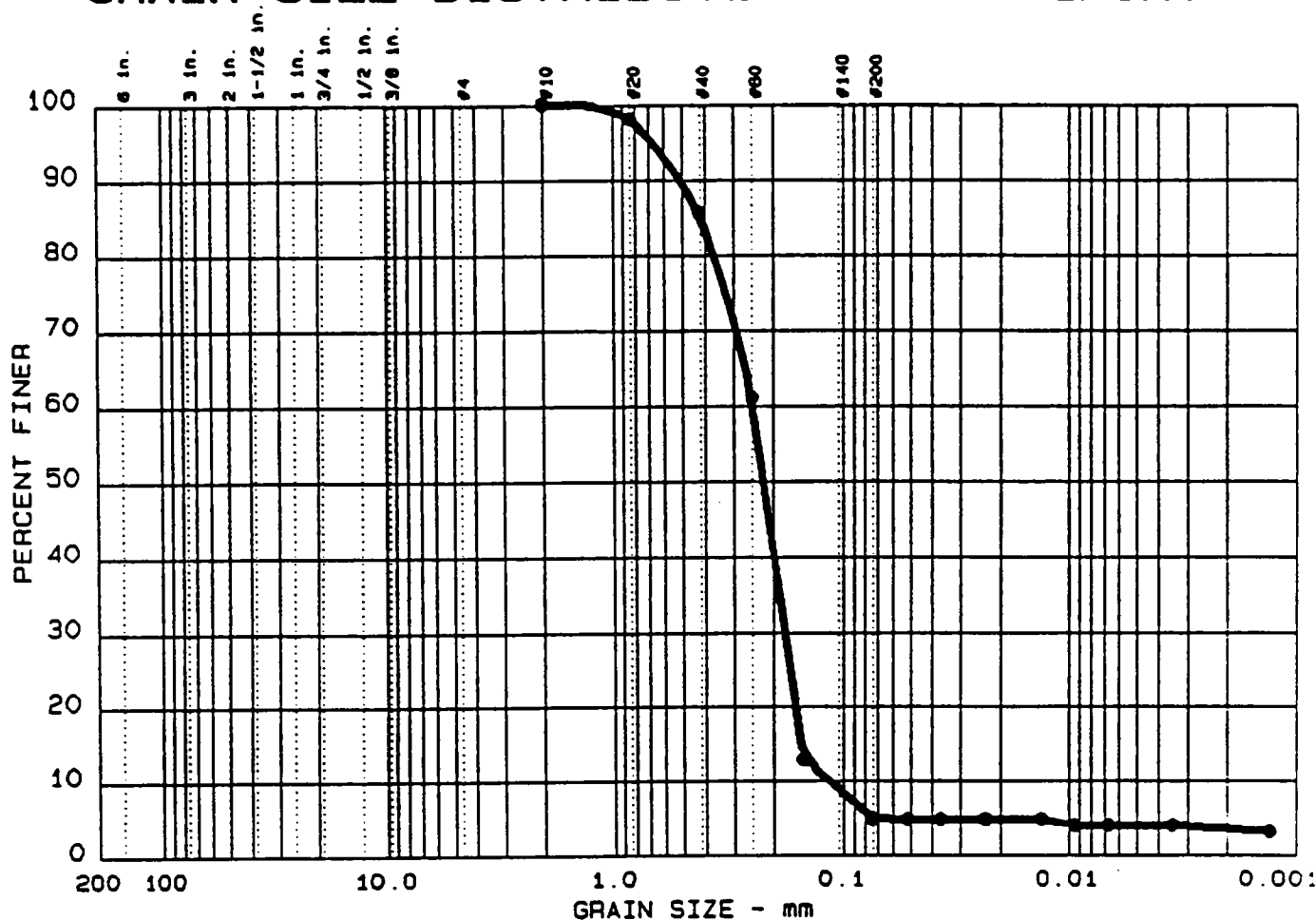
HYDRAULIC CONDUCTIVITY (K) DETERMINED FROM MERTSCH AND DENNY,
1966.

$$K = 0.32 \text{ cm/min}$$

$$\text{or } K = (0.32 \frac{\text{cm}}{\text{min}}) (0.03281 \frac{\text{ft}}{\text{cm}}) (1440 \frac{\text{min}}{\text{day}}) = 15.1 \frac{\text{ft}}{\text{day}}$$

REFERENCE: FREEZE and CHERRY, 1979, pp 350-351.

GRAIN SIZE DISTRIBUTION TEST REPORT



% +75 _{mm}	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	95.1	0.9	4.0

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		0.41	0.25	0.22	0.179	0.1524	0.1156	1.12	2.1

MATERIAL DESCRIPTION	USCS	AASHTO
● 13GW28, S-5		

Project No.: 475-07174-04
 Project: NAVY TANK FARM A CAP
 ● Location: 13GW28, S-5

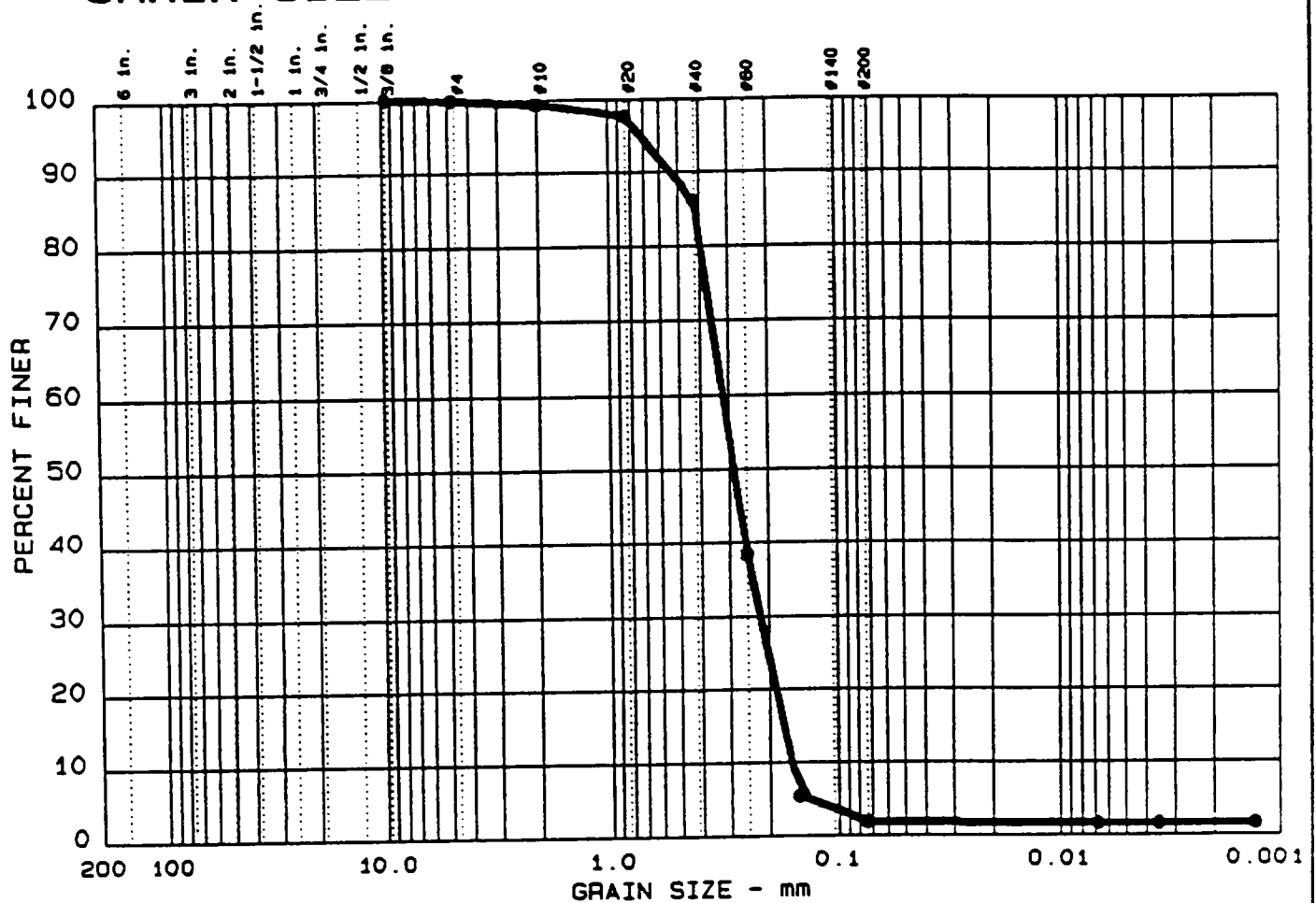
Date: 12-31-91

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING

Remarks:

Figure No. 1

GRAIN SIZE DISTRIBUTION TEST REPORT



%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.2	98.0	0.3	1.5

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		0.41	0.32	0.29	0.219	0.1732	0.1598	0.95	2.0

MATERIAL DESCRIPTION	USCS	AASHTO
● 13GW28, S-6		

Project No.: 475-07174-04
 Project: NAVY TANK FARM A CAP
 ● Location: 13GW28, S-6

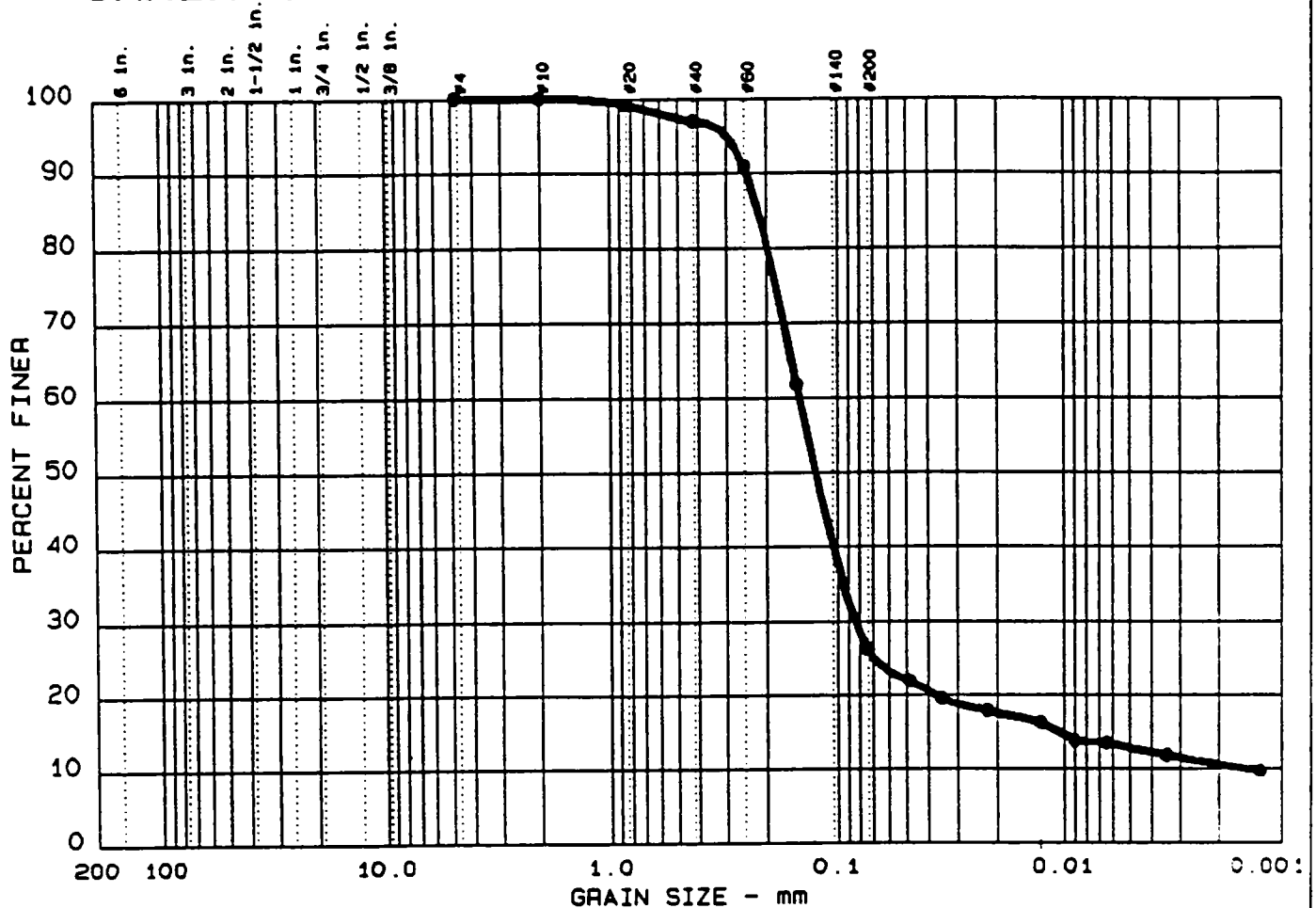
Date: 12-31-91

GRAIN SIZE DISTRIBUTION TEST REPORT
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Remarks:

Figure No. 2

GRAIN SIZE DISTRIBUTION TEST REPORT



% +75 _{mm}	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	73.8	13.5	12.7

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		0.22	0.14	0.12	0.084	0.0107	0.0014	35.65	106.7

MATERIAL DESCRIPTION	USCS	AASHTO
● 13GW29, S-4		

Project No.: 475-07174-04
 Project: NAVY TANK FARM A CAP
 ● Location: 13GW29, S-4

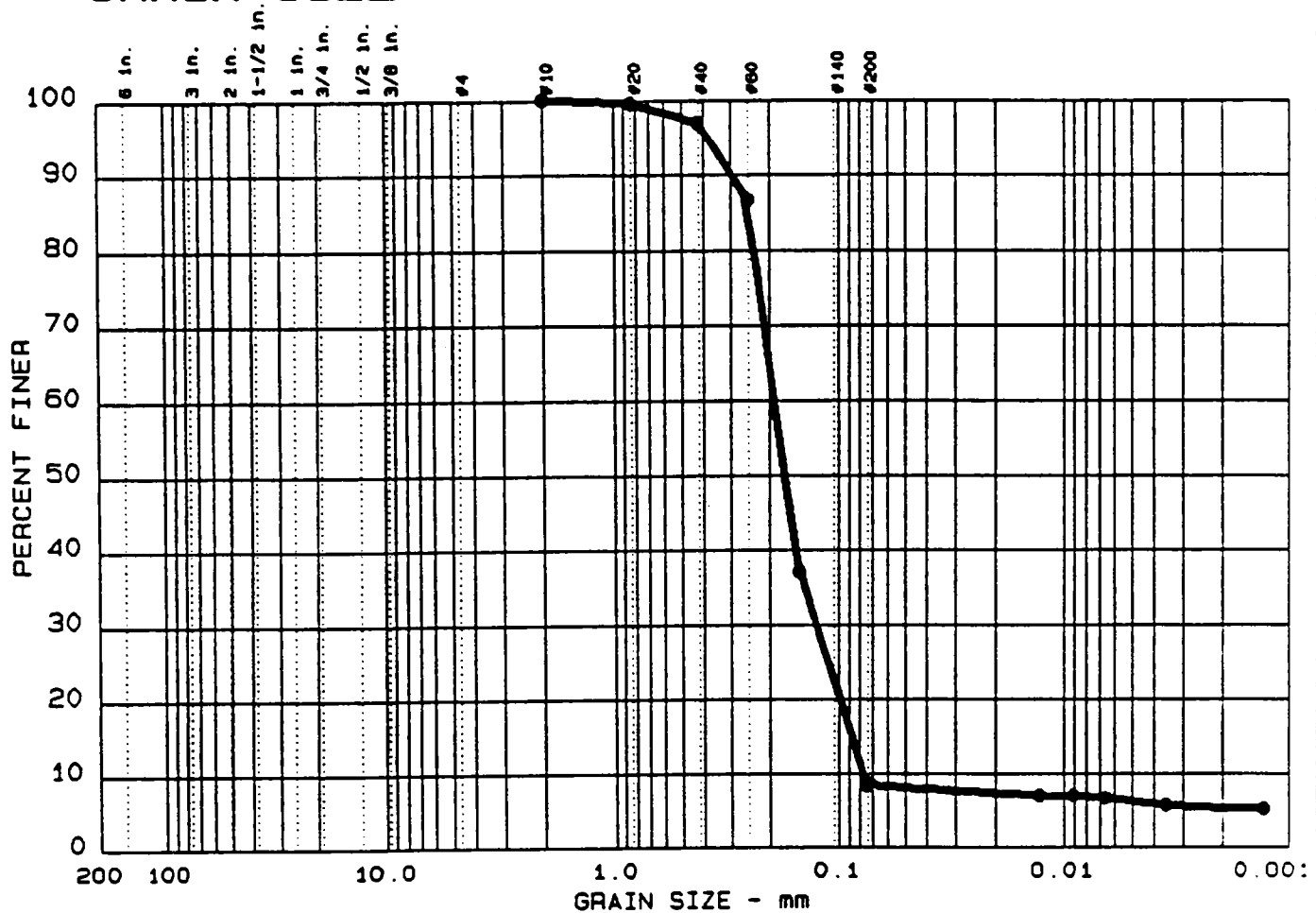
Date: 12-31-91

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING

Remarks:

Figure No. 3

GRAIN SIZE DISTRIBUTION TEST REPORT



%+75 mm	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	91.6	2.2	6.2

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
		0.25	0.19	0.17	0.125	0.0869	0.0769	1.06	2.5

MATERIAL DESCRIPTION	USCS	AASHTO
● 13GW29, S-5		

Project No.: 475-07174-04
 Project: NAVY TANK FARM A CAP
 ● Location: 13GW29, S-5

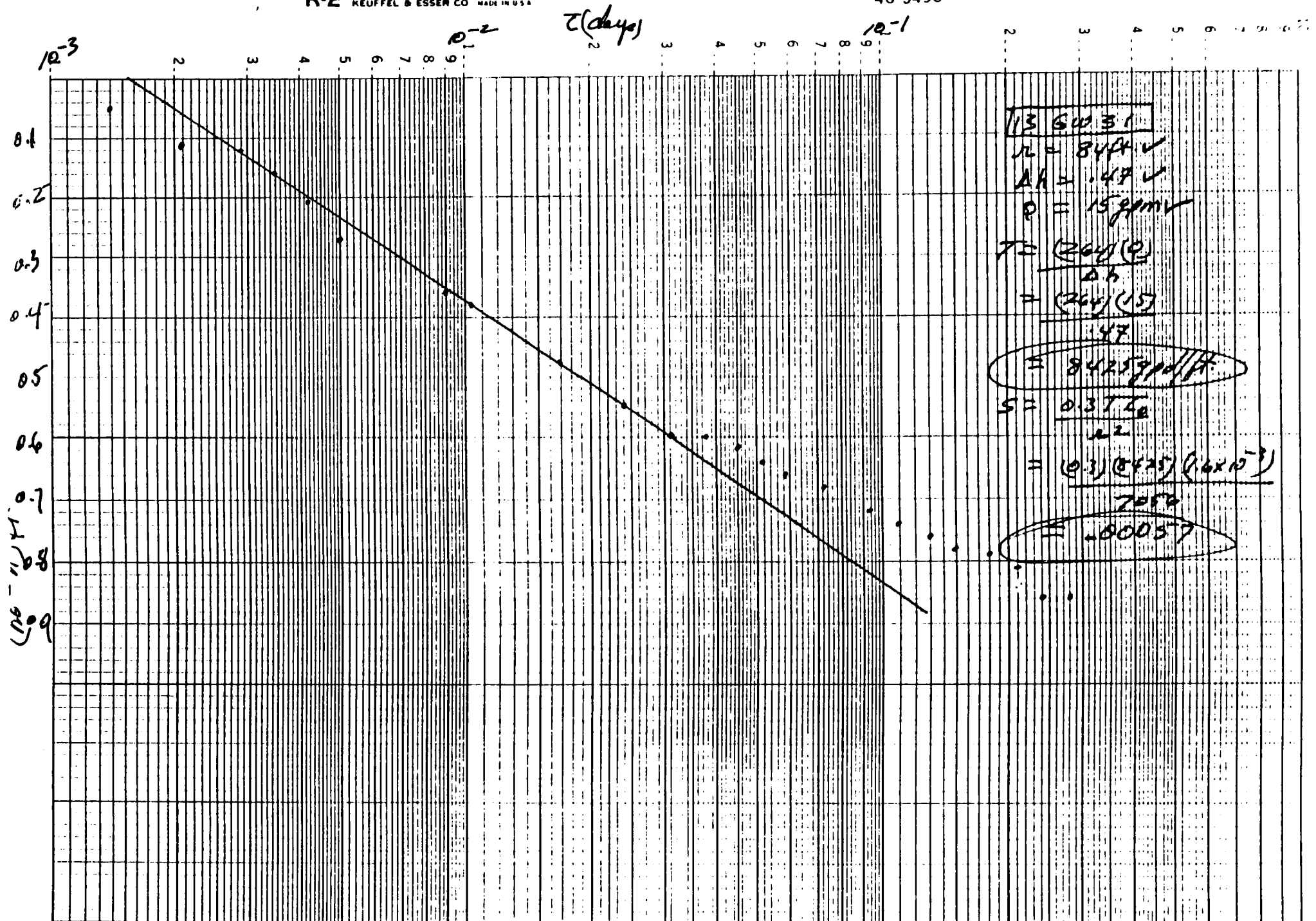
Date: 12-31-91

GRAIN SIZE DISTRIBUTION TEST REPORT

LAW ENGINEERING

Remarks:

Figure No. 4



13 6031

$$\mu = 844 \text{ V}$$

$$\Delta h = .47 \text{ V}$$

$$\rho = 15 \text{ ppmV}$$

$$T = \frac{(264)(\rho)}{\Delta h}$$

$$= \frac{(264)(15)}{.47}$$

$$= 84259 \text{ ppmV}$$

$$S = \frac{0.37 T_0}{\mu^2}$$

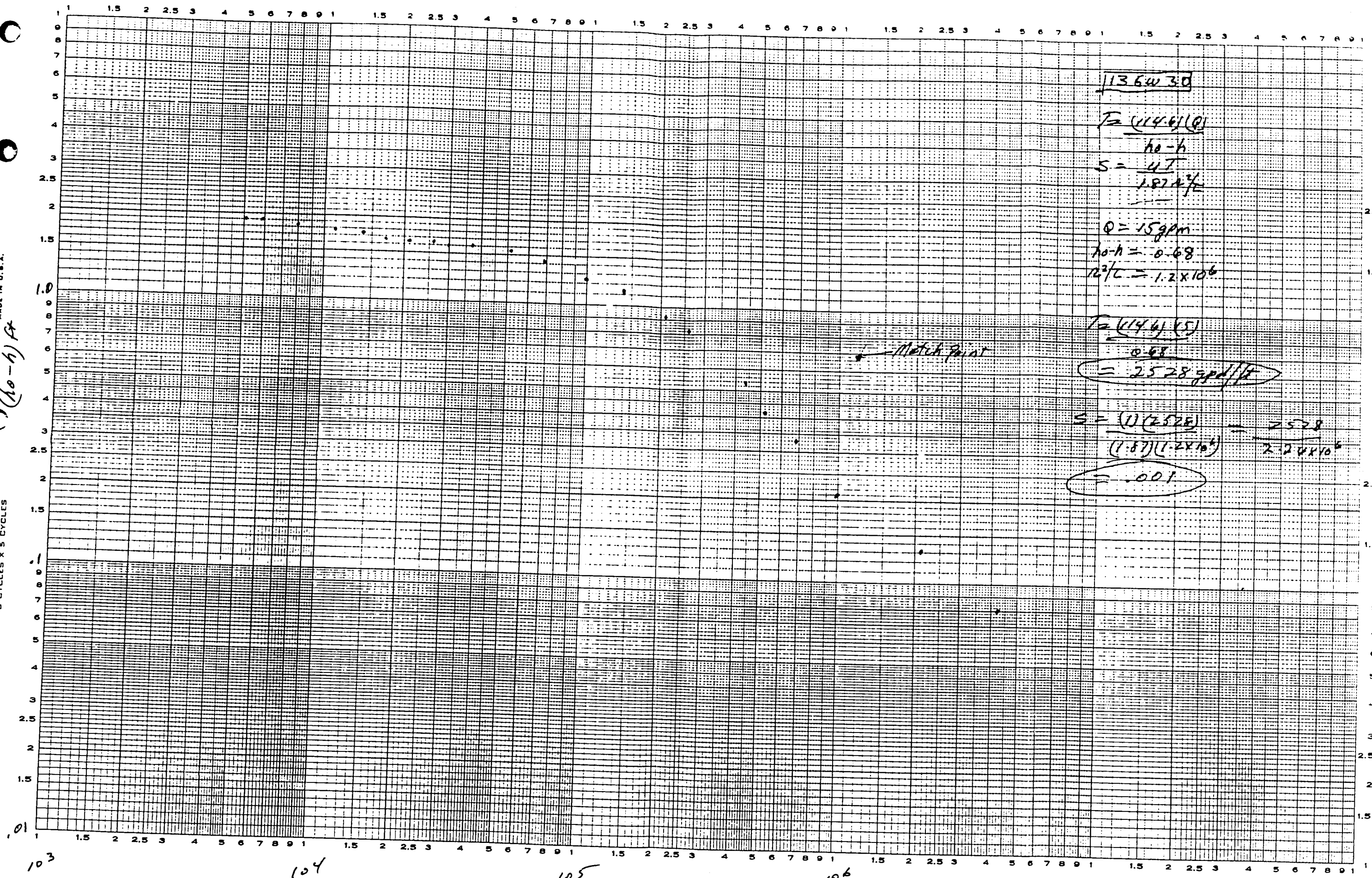
$$= \frac{(0.3)(8425)(1.6 \times 10^{-3})}{7050}$$

$$= .00057$$

DIETZEN CORPORATION
MADE IN U.S.A.

NO. 3410-L35 DIETZEN GRAPH PAPER
LOGARITHMIC
3 CYCLES X 5 CYCLES

$(h_0 - h) / L$



$$13.6430$$

$$T = (14.6) / (Q)$$

$$h_0 - h$$

$$S = \frac{4T}{1.87 \sqrt{L}}$$

$$Q = 15 \text{ gpm}$$

$$h_0 - h = 0.68$$

$$r^2 / L = 1.2 \times 10^6$$

$$T = (14.6) / (15)$$

$$0.68$$

$$= 2528 \text{ gpd/ft}$$

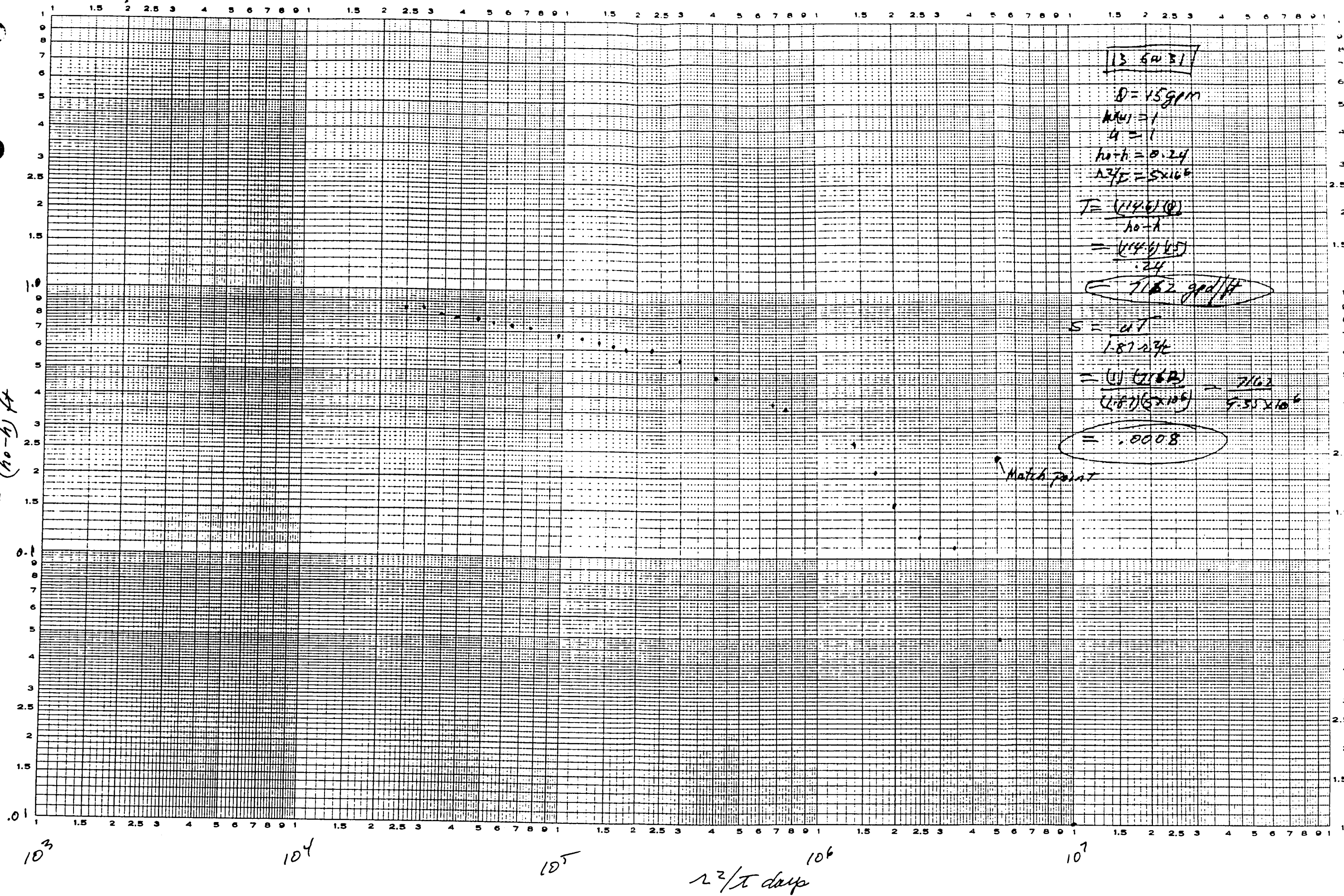
$$S = \frac{(1)(2528)}{(1.87)(1.2 \times 10^6)} = \frac{2528}{2.24 \times 10^6}$$

$$= .001$$

$r^2 / T (\text{days})$

DIETZEN CORPORATION
MADE IN U.S.A.

NO. 341D-L35 DIETZEN GRAPH PAPER
LOGARITHMIC
3 CYCLES X 5 CYCLES
(h_o-h) ft



APPENDIX I
ANALYTICAL DATA REVIEW REPORT



LAW ENVIRONMENTAL, INC.

NATIONAL LABORATORIES DIVISION
7215 PINE FOREST ROAD
PENSACOLA, FLORIDA 32526
904-944-8772
FAX 904-944-9463

January 23, 1992

Douglas Dixon
Law Engineering, Inc.
3301 Atlantic Avenue
Raleigh, NC 27604

Dear Mr. Dixon:

Please find enclosed the laboratory report data evaluation on the samples analyzed from Cherry Point, Law project #475-07174 Task 04 and 05. Attachment (1) addresses specific findings and is subdivided into QA/QC, Holding Times, Blank Contamination, Documentation, and General Comment sections. All items presented in Attachment (1) are not considered to have a major impact on the data reported.

If you have any further questions concerning this report, please feel free to contact me at (904) 944-9772.

Sincerely,
Law Environmental, Inc.

D. Abbott

D. Abbott
MIS Manager

encl Attachment (1)

cc James Tucci, LENL-Pensacola

Cherry Point
Analytical Data Review

QA/QC:

All surrogates from 601/602 and 610 analyses were within control limits.

All internal standards from 602 and 610 analyses were within control limits. All 601 internal standards were within control limits with the exception of sample AA15423 TRIP BLANK taken on 11/20/91. The internal standard for this sample was not present since the concentration was calculated using an External Standard method versus the Internal Standard method.

All matrix spike/matrix spike duplicates (MS/MSD) for each analysis were within control limits with the exception of sample HP-11S for 601/602 analyses.

Parameter	MS	MSD
-----	-----	-----
1,2-Bromochlorobenzene	142	140
Ethylbenzene	152	151

Initial and Continuing Calibration Verification (ICV/CCV):

<u>Run</u>	<u>Failure</u>	<u>Samples Associated with CCV</u>
Lead	CCV1=87%	HP-3S (AA15414) HP-5D (AA15417) HP-6D (AA15418)
Lead	CCV1=111% CCV2=114%	HP-14S (AA16520)
PAH	ICV: 1-Methylnaphthalene and 2-methylnaphthalene not present in solution.	Potable Water (AA15379)

All ICV/CCV failures are marginal, in both cases, the acceptance criteria was missed by less than 4%. This margin does not represent any significant biases in the data.

Holding Times:

All analyses were performed within specified holding times.

Cherry Point
Analytical Data Review

Blank Contamination:

Low levels of contaminants were observed in the Trip/Rinse Blanks listed below:

<u>Sample ID</u>	<u>Lab ID</u>	<u>Compound Present (Concentration)</u>
Trip Blank	AA15378	Xylene (1.8 ug/L)
Rinse Blank	AA15720	Chloroform (2.1 ug/L)
Trip Blank	AA15721	Xylene (1.1 ug/L)
Trip Blank	AA15423	Xylene (1.1 ug/L)

All laboratory blanks were free of contamination.

Documentation (Final Report):

1. Time reported on the final report is not correct for the samples listed below:

8GW25-S5 (AA16014) reported 10:15 should be 10:10
8GW25-S6 (AA16015) reported 10:10 should be 10:15

2. Time not listed on chain of custody:

13GW26	(AA16377)
8GW22	(AA16382)
8GW26	(AA16383)
PT-A,B	(AA15996)
13GW28	(AA16459)
8GWRB	(AA16384)
13GW29	(AA16379)
13GW27	(AA16378)
13GW29-S4	(AA16043)
13GW29-S5	(AA16044)
13GW28-S5	(AA16045)
13GW28-S6	(AA16046)
HP-11S	(AA16114)
HP-14S	(AA16520)

3. The detection limit on the final report for 8GW22-S5 (AA15779) for Gasoline is 2.0, this detection limit should read 0.2.

4. The detection limit on the final report for 8GW22-S5

Cherry Point
Analytical Data Review

(AA15779) for lead is 20, this detection limit should read 200.

5. The flashpoint result on the final report is >200, the actual result should be 129.

Note: This flashpoint result change is below the limit set by current Land Disposal Restrictions limits.